THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

[REGISTERED AS A NEWSPAPER.]

VOL. XXIV. No. 598.] LONDON, OCTOBER 27, 1874. [26TH YEAR.] Price 6d.

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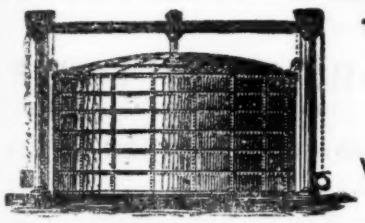

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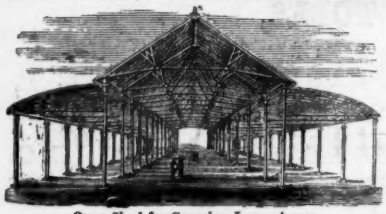

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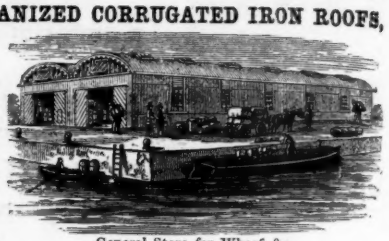

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GIVES MORE GAS PER TON OF COAL. WITH HIGHER ILLUMINATING POWER, SATISFACTION, AND PROFIT TO SHAREHOLDERS AND MANAGERS.

IS STRONG, SIMPLE, EASILY FIXED AND WORKED, AND THOROUGHLY EFFICIENT AT ALL TIMES.

TESTIMONIAL.

Gas-Works, Guildford, Sept. 15, 1874.

GENTLEMEN,—The five retorts fitted with your Patent Moveable Seal for Dip-Pipes, on June 30, have been in constant use since that date, and have worked in a most satisfactory manner.

These Retorts are still quite clean and free from carbon, whilst others not so fitted, after being at work eight weeks, required scurfing, having a deposit of carbon 2 inches in thickness on the inside.

I also find a slight increase in the yield of gas per ton of coal carbonized, although your Patent Seals are fitted to but one-fifth of the Retorts now at work.

As your statements respecting your apparatus are fully confirmed by the results obtained in practical working, I should wish you at once to fix one to each of the ovens at these works, that I may obtain all possible advantage during the coming winter.

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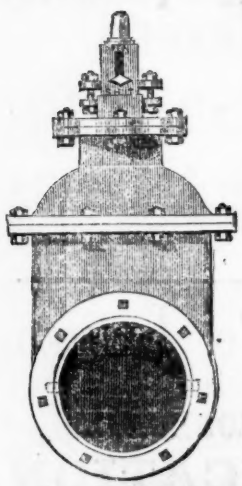


These solidly constructed double-faced Gas-Valves are superseding the old system of the light, single-faced disc, which is too uncertain and unreliable in large bores.

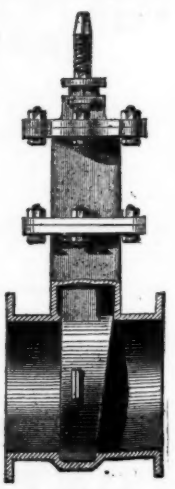
They are guaranteed absolutely gas-tight. They are very massive and rigid, and by improved modes of manufacture they are produced at very little excess in cost over the old light, weak system, which is liable to spring and bend, and become leaky.

The Valve is a rigid wedge of solid cast iron, having two perfectly scraped surfaced facings fitting between the two on the body, which are also surfaced.

A spring in two short halves, and, therefore, not liable to break, is used only for scraping the front facing clean.

The front facing is vertical; the back facing forms the wedge.

At a slight additional expense both flanges are faced to bolt to main-pipes.



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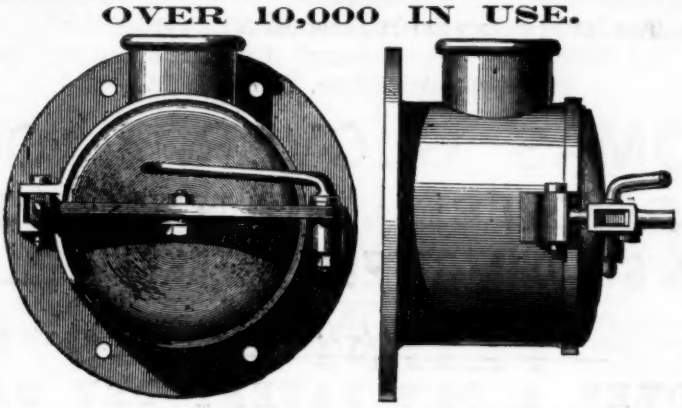

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NO DUPLICATE LIDS REQUIRED.

These Lids are proved by many eminent Gas Engineers to be the most efficient, saving much time, labour, and expense; are opened and closed as quickly and with as little trouble as an ordinary furnace door, and by their use the Retorts are soundly sealed during the whole period of carbonization.

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„ Independent Gaslight Company.	„ Commercial Gas Company.	„ Birkenhead Gas-Works.	„ St. Alban's Gas-Works.
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The Morton's Lid is made circular in form, that being the most convenient and suitable shape. It can be used for Retorts of any section, by adapting the Mouthpiece casting from the D, oval, or other shape, at the back, to circular in front.

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(Commonly called the Chartered Gas Company),

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I should be very sorry to return to the old system of Luting, and our stokers here freely acknowledge the benefit to them of the new system.

I am, yours truly,

(Signed) G. C. TREWBY.

P.S.—We shall have very shortly about 3000 of your Lids in use.

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The following are a few of the leading Sizes:—

Diameter of Steam Cylinder.	Diameter of Water Cylinder.	Length of Stroke.	Gallons per Hour, Approximate.	Price.
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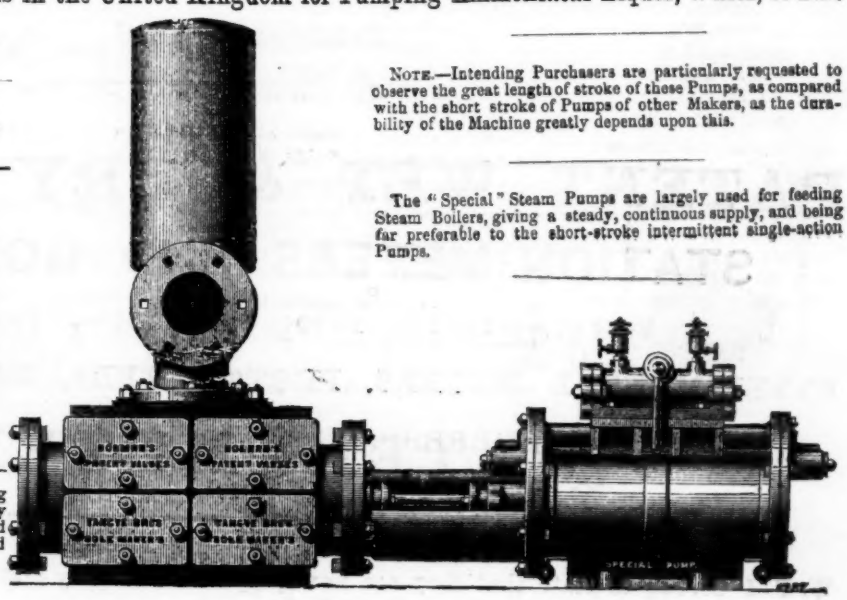
3	3	9	2,200	18
4*	3	12	2,200	20
6*	3	12	2,200	25
4	4	12	3,900	25
6*	4	12	3,900	30
6	5	12	6,100	35
7*	5	12	6,100	40
6	6	12	8,800	40
8*	6	12	8,800	50
7	7	12	11,900	50
10	7	12	11,900	65
8	8	18	15,660	65
10	8	18	15,660	75
10	10	24	24,400	100

* These sizes being usually selected for pumping Tar and Liquor, are always in stock, or nearly ready, fitted with all pump details in iron, and extra length distance piece between steam and pump cylinder at a small extra cost.



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Paris, 1867.

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5th, Are the most accurate and unvarying measurers of Gas;
6th, Prevent jumping or unexpected extinction of the Lights;
7th, May be fixed either above or below the level of the Lights;
8th, Cannot be tampered with, without visibly damaging the outer case;
9th, Will last much longer than Wet Meters;
10th, Will not cost more than one-half for repair that Wet or Water Meters do;
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WATER METERS.

W. P. & Co. beg to state that they are now prepared to supply Station-Meters with planed joints.

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No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

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THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, OCTOBER 27, 1874.

Circular to Gas Companies.

It was stated a few days ago, in the *Daily News*, that it was likely that the Metropolitan Board of Works would not, after all, proceed with the measure they have prepared to obtain power to set up competing gas-works. We have no knowledge of the source of our contemporary's information, and may reasonably question its accuracy. The Bill, we have little doubt, will be proceeded with so far as to give it an actual introduction to Parliament. What is likely to happen to it then it is not for us at the present moment to hint or conjecture. The Bill of the Corporation of London will, of course, share the fate of that of the Board of Works, whatever it may be.

Before our last issue was in the hands of our readers, we were favoured with a copy of the "Draft of a Bill for creating a County "and Municipality of London," &c., and were gratified to find that the suggestions we made had been already adopted in the Bill. The importance of the measure is so great that we may here give a short outline of its provisions. It is proposed to constitute one municipality for the metropolis, as defined by the Metropolis Management Act, 1855. This is to constitute a "county," which it is proposed to divide into ten districts. Each district will return a certain number of councillors, who will be elected by householders, and a certain number of aldermen, who are to be elected by the councillors. The elections are to take place in accordance with the provisions of Lord John Russell's Municipal Corporations Act, 1835, which this Bill proposes in the main to apply to the metropolis. As regards aldermen, however, it is intended to elect them for only three years, the same time as the councillors will serve. We confess that we should have preferred to see the constitution of the Corporation of the City of London more closely copied in this part of the Bill. We think the councillors should be elected annually; the aldermen might be elected for five or six years, but they should be the direct representatives of the ratepayers, and not the elect of the councillors. The post would be robbed of half its honour if an alderman were merely a nominee of the councilmen.

It is proposed that the new council shall consist of 200 councillors and 36 aldermen. We need not occupy our space with an account of the number to be elected by each of the ten districts, for that is a part of the Bill which is certain to undergo modification. The principle to be kept in view in allotting the numbers is, to our minds, the rateable value of each district. The numbers should be so apportioned that the "*fiscal power*" of each representative should be as nearly as possible equal. We should be straying into politics if we here pointed out the differences between municipal and political representatives, and we shall only remark that in the former case the representation of mere numbers is not to be thought of.

The election of Lord Mayor may be fitly left to the council, who may, we think, be depended upon to elect the best, if not the richest men for the office. It is unnecessary to say that the suggestion put forward by the leading journal—viz., that the Lord Mayor should be nominated by the Crown—cannot for a moment be entertained. We must not have a Prefect of the Thames, after the Parisian model.

Without occupying much more of our space on the matter, we may glance for a moment on the opposition to the measure which may be anticipated. Vestrydom will, of course, soon be up in arms, and all those whose vanity is flattered, or whose interests are promoted, by the present confusion, will be certain to raise the cry that a Corporation will only increase the rates; and the groaning ratepayers will, probably, listen to them for a time. The Metropolitan Board of Works, we are inclined to think, will die easily, the members being certain of a transformation into councillors. It is at Guildhall that the great opposition will arise. Clause 31 of the Bill, which provides that the new "Municipality "of London shall hold, receive, and take all *real and personal pro-* "*perty* . . . vested in . . . the Corporation of the "City of London . . . and apply the same as the corporate "property of the municipality of London, for the public benefit of "the inhabitants of the metropolis," will be the cause of an outcry of "confiscation," which may resound through the length and breadth of the land. The men who would, without compunction, confiscate the property of widows and orphans who happen to be gas shareholders, will resist to the utmost the application of a farthing of "City" funds to the benefit of a soul outside that magic area of 668 statute acres. A circular from Guildhall will endeavour to persuade all the Corporations in the kingdom to join in the outcry, and will succeed with a few. The ultimate result, however, cannot be doubtful. The work left incomplete in 1835 must now be finished and perfected. If the present Government wish to leave their mark on the social history of the country, they will take up the work with earnestness, the more so because they may calculate with certainty on the support of the opposition. We do not expect to see the Bill before us pass as it is; we cannot hope to see any Bill having the same object become law for the next two or three years; but we may now congratulate the promoters of this measure on having put forward the best and most complete scheme yet devised for the constitution of a municipality for London.

We notice that the Metropolitan Municipal Association have some idea of trying their hands at gas legislation, but cannot help thinking that they will see the propriety of refraining for the present from any attempt to disturb existing conditions. Until the new municipality is constituted they may rest content with the honour of having assisted in the passing of the City of London Gas Act, 1868, which, according to the statement of the honorary secretary of the association, has saved the citizens no less than £685,000. According to the same authority, the public have gained £600,000 a year since the passing of the Metropolis Gas Act, 1860. Without endorsing the absolute accuracy of

these figures, we may confidently assert that the benefits the metropolis has derived from these two Acts have been immense, and but for the abnormal increase in the cost of coal, and consequently inevitable rise in the price of gas, no one would have dreamed of further gas legislation. We may, however, candidly admit an excuse for the present agitation. There will certainly be a demand for *further legislation* if bread should ever again be at 1s. 10d. the quartern loaf, and present occurrences will furnish a limited precedent.

The accounts of the Independent Gas Company for the past half year tell the usual tale—a deficiency of profits, which has to be made up from the reserve-fund. It amounts, however, to only £5593, and the reserve-fund is over £24,000, so the company can well stand the drain.

A strange fatality clings to the unfortunate Dublin and Alliance Gas Company. They have had another fire in their coal store, and the stock of coal, of which the chairman so recently boasted, is converted for the most part into cinders and bad coke. We presume this fire also was of spontaneous origin, and it would seem that the lesson of the former fire was neglected. There is little excuse to be made for a fire in a coal store, but we will not blame the present management, whose attention finds sufficient occupation elsewhere. We fervently hope the latest accounts are correct, which represent the loss as not nearly so great as at first reported.

We presume it would be utterly hopeless for the Sheffield Gas Company to attempt to please everybody in that borough. There is nothing to allege against the gas, which averages 19-candle power, according to the London standard; and the price is only 3s. 1d. per 1000 feet. There is, in fact, a cessation or suspension of the long-standing feud between the Corporation and the company. Something, however, must be found for certain people to grumble about, and it is discovered in the circumstance that the company are erecting new offices in a somewhat costly and pretentious style of architecture. They will, when completed, prove an ornament to Sheffield, a town which certainly stands in want of ornamentation. This is the present grievance against the gas company. There are, it is true, subsidiary complaints, most unreasonable in their nature. Glasgow is referred to, and a comparison is made of the capital engaged in the Glasgow works and that expended by the Sheffield Company. The capital of the latter may be admitted to be high, but that is no fault of the present management. The expenditure was forced upon them by circumstances over which they had no control. Then some wish for cannel gas, which would be out of place in Sheffield, where gas is, to some extent, and ought to be to a great extent, used for industrial purposes. Nor is cannel gas so cheap as the Sheffield grumbler supposes. If he wishes to see blackened ceilings in perfection, he must go to some Scottish town lighted with cannel gas to be gratified; and as regards other matters, we undertake to say that any candid observer would return home more than satisfied to enjoy 19-candle gas at a cost of 3s. 1d. per 1000.

The dispute between the Bristol Gas Company and the Corporation and Sanitary Authority has been arranged on terms which ought to be satisfactory to the latter. The public lamps are now to be supplied at the rate of 3s. 4½d. per 1000, the lowest price to a private consumer being 3s. 10d. It is further agreed that the price shall be subject to revision at the end of every year (the contract being made for three years), and supposing a reduction to have been made in the price to private consumers, the authority are to be allowed two-thirds of that reduction. There will now be an end, at all events for some time, of all talk of the purchase of the company.

The gas-works of the Burnley Corporation have returned the moderate profit of £3900 for the past year, and coal being now at a lower price, the Gas Committee recommended a reduction in the price of gas of 4d. per 1000. At a meeting of the Town Council, however, a resolution was carried which fixes the price for the next year at 3s., a reduction of 8d. At this rate the Corporation will not make much profit, but they will have the satisfaction of knowing that they are managing their undertaking on correct principles. The reduction in Burnley makes the neighbouring people at Rossendale, who are supplied by the Rossendale Union Company at 5s. 10d. per 1000, very discontented. It certainly must be regarded as a misfortune for consumers that a gas company should be compelled to make a profit, if possible.

The Town Council of Pontefract are extremely anxious to see a competing gas company in the borough, and wish to know whether it is competent for them to grant a concession to a new company for a number of years, to take up the pavements, &c. We know of no obstacle in the way of such a grant by the council; but we see a great many difficulties to be encountered if any company have the temerity to attempt to avail themselves of it.

The directors of the Southampton Gaslight Company have intimated to the Town Council their willingness to recommend the proprietors to dispose of the whole undertaking to the Corporation, if proper terms be offered. The negotiations will, of course, occupy some time, but the necessary parliamentary notices will be given this year.

The agitation for the acquisition of the Swansea Gas-Works by the Corporation gathers strength, and there is, we believe, a possibility that the undertaking will be transferred next year.

At Halesworth, a small town in Suffolk, with about 2500 inhabitants, gas is evidently considered a luxury, and not a necessary of life; for, at a recent parish meeting, it was resolved—"That it would be expedient, while the extreme rate is charged for gas, to discontinue lighting the lamps in the public streets." What the "extreme rate" is we do not exactly know. The parish offered 5s. 10d. per 1000, which the gas company declined to accept; so Halesworth, as a local contemporary puts it, is "doomed to darkness."

Sittingbourne grumbles at gas at the price of 6s. 10d. per 1000, and the inhabitants talk of bringing pressure to bear on the proprietor of the works. Why do not the Improvement Commissioners purchase the undertaking, and show how cheaply gas may be supplied?

We believe that the parish of St. James, considering the importance of its thoroughfares, is about the worst lighted in London; for proof, let any one look at Piccadilly Circus. We are bound to say, however, that a great improvement on a small scale has recently been made by the introduction of a lamp which is described and figured in another column. We have carefully tested these lamps, and are free to say that we consider them among the very best yet experimented with. The burners and regulators, it is true, are new in those put up, and therefore a full consumption is ensured; but the form and structure of the lantern make it certain that the minimum of light will be lost. One incidental recommendation is that the names of the streets can be put conspicuously on the lantern without obstructing much light.

Attention may here be called to an interesting paper we publish to-day, read at the last meeting of the West of Scotland Association of Gas Managers, "On the Absorption of the Illuminating Constituents of Coal Gas by Heavy Hydrocarbon Oils." None of the facts stated, we may say, are new. It has long been known that, on passing coal gas through these oils, all the light giving vapours (*i. e.*, benzole, &c.) are abstracted, and that there is in consequence a diminished luminosity in the gas-flame. Mr. Cusiter, however, deserves great credit for having ascertained the extent to which the depreciation takes place. Further experiments will be required to determine exactly what is absorbed by the oils, for we have great doubts of the absorption of any permanent gas. We do not at this moment see the utility of the practical application to the testing of gas suggested, but admit that it may be used to determine the amount of illuminating "vapour" in a rich gas.

Water and Sanitary Notes.

The paper read by Dr. Letheby at the meeting of the Society of Medical Officers of Health, an abstract of which we publish elsewhere, will be studied with earnestness by all who take a scientific interest in vital statistics. We are at liberty to remark here that the subject seemed to possess little interest to "medical officers," who were conspicuous by their absence. If the question to be discussed had been one of fees, they would have been present in a body; but the common run of our medical officers are altogether at sea on scientific questions, and perhaps wisely abstain from mixing themselves up with them. Passing to the subject of the paper, we may say that, however just Dr. Letheby's objections to the Registrar-General's returns may be, it must nevertheless be admitted that these returns do express facts. When, for example, the Registrar-General reports that the mortality in London, in any given week, was at the rate of 23 per 1000, in Salford 30 per 1000, and in Glasgow 34 per 1000, we know it to be true. But the inference suggested may be entirely fallacious. Glasgow may, after all, be the healthiest town of the three, and yet appear to have the highest death-rate. But when we come to differentiate the causes of mortality, we get lost in a maze. That the birth-rate largly influences the death-rate is unquestionable; but is it a law of nature that 46·5 per 1000 of the children shall die in the first month of their existence? If so, let these deaths be struck out of the returns, and one source of fallacy will be removed. There can be no doubt that the morals and the personal and social habits of the people, irrespective of what we may call public sanitary conditions, largely influence the death-rate of a community; but how can we express the variable contributions of these several factors to the rate of mortality? On the whole, while admitting to the full the truth of all Dr.

Letheby's propositions, we must confess that we are at a loss for a mode of expressing the broad facts other than that adopted by the Registrar-General. The subject is, however, of too great importance to be disposed of cursorily, and we may return to it on a future occasion.

The water-works of Hull, we are happy to say, are being reinstated in a proper condition, and a full supply, we hope, will be given in the course of another week.

The Liverpool Gas Company have been, as already stated, justly blamed for their exactions of deposits. It is with a grim satisfaction that we read complaints of the administration of the water undertaking of the Corporation, which, if well founded, will show consumers what they may anticipate when the gas undertaking is in the same hands. The correspondent of a Liverpool paper writes as follows: "First, the owners of property are compelled "to take the water, and then all kinds of mischievous conditions "are imposed under which it is to be used. The legal maxim "that 'Every wrong has its right,' has its truth shown in this "matter by the power given to the magistrates to punish those "who allow water to run to waste; but the Water Committee, "in addition to using this remedy, which is sufficient for the "purpose, commit a greater wrong by allowing unjust exactions." The exactions referred to are alleged capricious alterations in the fittings allowed, one thing being certified as proper to-day, and a certificate being refused for the same thing to-morrow. The question of the day in Liverpool is cisterns, which, no doubt, are a source of enormous waste. We read that 26,000 of these have been condemned; but the Corporation will have to exercise forbearance, or they will earn a worse name than the gas company.

We mentioned in our last that the Corporation of Dublin were threatened with a seizure of their goods and chattels to satisfy a claim for rates due on their water-mains. The Corporation, as we said once before, are utterly impecunious, and they have had to take counsel's opinions as to how and from what fund the money could be obtained. Counsel were clearly of opinion that the Corporation must apply the water-works fund, and that fund only, to the discharge of the liability. The expenditure was necessary for the purposes of the water-works, and, being a charge created by law, it must be taken to have been contemplated by the Legislature when fixing the rating powers given to carry out the water-works. The Town Council, therefore, carried a resolution to the following effect:—"That the Water-Works "Committee be authorized and empowered to borrow, upon the "security of the water-works fund and the borough fund, the "amount now due to the Collector-General of Rates, and to "pay same forthwith in discharge of the judgment and costs now "imminent, and by way of salvage, and to preserve the corporate "property, and that the city seal be affixed to such security if "necessary."

Correspondence.

A QUERY.

SIR,—In the paper published in the JOURNAL of the 13th inst., "On the Science and Practice of the Manufacture and Distribution of Coal Gas," I observe a rule of Mr. Bannister's for obtaining 10 per cent. of sulphuric acid for alkalimeter testing purposes.

Now I should feel obliged if some of your numerous readers would explain why 10 per cent. of sulphuric acid should not have a specific gravity equal to 1084·5 instead of 1068·2.

For 1000 × 9 = 9000
And 1845 × 1 = 1845

10)10845

1084·5

And a pound of sulphuric acid can neither measure the tenth of a gallon nor be equal to the tenth part of the mixture's weight.

Should the rule not be—Mix a liquid pound of sulphuric acid with nine liquid pounds of water, their sum being equal to a gallon, and their specific gravity would equal 1084·5?

I shall be happy should any one correct me and show me where I am wrong; but if I am right, what will the ammonia distillers who have purchased with sp. gr. 1068·2 think of the matter?

ALPHA.

RELATIVE PRICE OF COMMERCIAL AND CHARTERED GAS.

SIR,—Mr. H. E. Jones, in replying to my letter in your JOURNAL of the 13th inst., is very severe upon my want of taste in making comparisons; but he weakens the force of his virtuous indignation when he refers to the gratuitous comparisons made by his chairman, to the discredit of companies working under the City of London Gas Act. Then they become "merely the complacent congratulations which usually fall from the lips of the chairman on such occasions."

In my communication I dealt only with the figures given by his chairman, and do not think I am open to the charge of suppressing the truth, and would just remind him that in making his comparison he only deals with one column of my figures; because the others, even under his mode of treatment, would scarcely bear out his conclusion, and the last column refers only to the present price of 5s. per 1000 feet, whereas the figures he quotes, as given by Mr. Keates in his evidence, refer to 1873, when the Chartered price was only 4s. 4d. per 1000.

I consider that the standard fixed by the Acts of Parliament is the proper one on which to base the calculations, as it is all that the companies are bound by, although his and all the other companies must, as they really do, work above it.

After giving credit for the two candles, which I candidly admit did slip my memory when I made the previous calculations, I find that the relative cost per candle is—

Chartered Company, at 3s. 9d. per 1000	.	2·85d.	per candle.
Ditto „ 4s. 4d.	„	3·25d.	„
Ditto „ 5s.	„	3·75d.	„
Commercial Company „ 4s.	„	3·42d.	„

I agree with Mr. Jones that at such a time as the present (especially) comparisons would be better avoided, and I was astonished, when I read his chairman's speech, that he should have wrapped up with his "complacent congratulations" any such remarks as those he made on other companies.

JUSTICE.

Oct. 22, 1874.

PELOUZE AND AUDOUIN'S LAST PATENT.

SIR,—My letter in your issue of Oct. 13 was not of a controversial character, and I have much pleasure in thanking M. Pelouze for the information he has given in explanation.

Allow me also to state, with regard to M. Pelouze's remark of "two gallons of water being made to absorb all the ammonia contained in 3500 cubic feet of gas," that my scrubber, with the patented improvements that have been effected in it during the past three years, completely absorbs all the ammonia contained in coal gas with 25 per cent. less water than the quantity named by M. Pelouze, the gas only once passing through, and producing a liquor of from 25 to 30 ounces commercial strength.

WILLIAM MANN.

Dorset Street, Oct. 24, 1874.

GENESIS OF THE MUNICIPAL CORPORATIONS (BOROUGH FUNDS) ACT.

SIR,—Referring to a paragraph in the JOURNAL of the 20th inst., respecting the genesis of "The Municipal Corporations (Borough Funds) Act," I beg to inform you that after the 1st day of January next any town-clerk in the kingdom, as also any secretary of any gas or water company, may see the original draft of this Act, and may read the correspondence relating to the genesis aforesaid, by applying to me at the following address.

M. B. JACKSON, C.E.

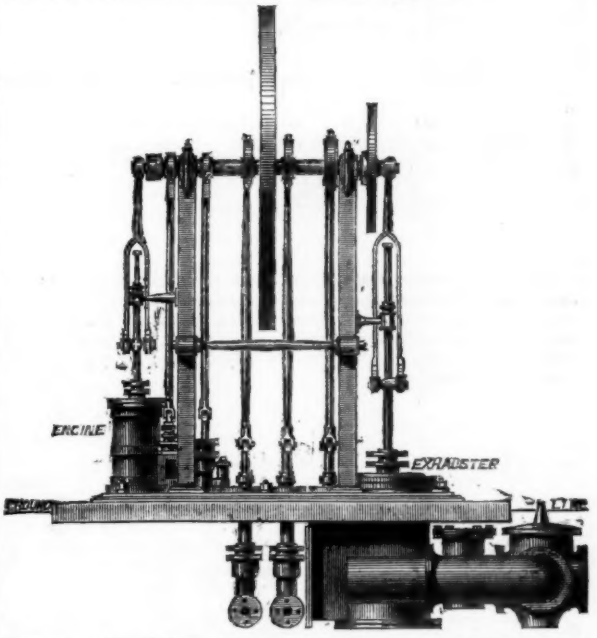
4, *Royal Parade, Cheltenham, Oct.* 24, 1874.

A TREATISE ON THE SCIENCE AND PRACTICE OF THE MANUFACTURE AND DISTRIBUTION OF COAL GAS.

XXXVI.

THE EXHAUSTER.

We now present an engraving of the piston and cylinder exhauster, as applied by Mr. George Anderson. The engine and exhauster are both attached to the same bed-plate, and actuated by the same shaft, and on the latter are the necessary eccentrics for working the valves of the two machines, as well as for driving the tar, ammoniacal liquor, and feed pumps. The whole is arranged in a remarkably simple and complete manner, which prevents the uncertainty of action, and saves the wear and tear of bands or straps, and the friction and noise of toothed wheels, or other kind of gearing. The combination altogether, embracing several different objects effected by very simple means, is a recommendation of this class of apparatus.



The capacity of the exhauster cylinder, as compared with that of the engine, is as about six to one; the valves are the ordinary slides, and the very few parts of the apparatus ensure a more reliable action than can be attained with the generality of these machines. Mr. Anderson claims, by the use of this exhauster, considerable economy in the fuel employed, and cites certain instances in corroboration of his statement.

We next direct the reader's attention to an apparatus for a similar purpose, but differing from all others alike in construction and mode of action—namely, the steam-exhauster invented and patented by Mr. Cleland, of Liverpool—which operates without the aid of any intermediate mechanical appliances, the exhaustion being effected simply by the admission of a jet of steam into a peculiarly formed pipe, enclosed within the main delivering the gas.

It is well known that a current or stream of air, when moving through the atmosphere in a state of calm, produces another current or stream around it Thus, if we blow into a still atmosphere, the current of our breath produces another current in the same direction.

The action is rendered more demonstrative by placing a small tube within and concentric to another of greater diameter and length, both their ends being open, when, by blowing into the smaller tube, a current of air is caused to pass through the larger tube; and to approach still closer to the invention under consideration, if a jet of steam be allowed to pass into the smaller pipe, a current of air or gas would flow through the larger. This is precisely the principle of Mr. Cleland's exhauster, and, as it possesses considerable ingenuity and novelty, we shall devote more than the usual space to the subject.

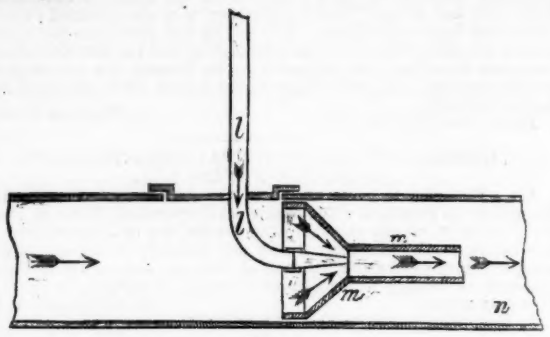


FIG. 1.

Fig. 1 illustrates the action of this exhauster in its simplest form. Within the main, *n*, conveying the gas is placed a funnel-shaped vessel, *m m*. The pipe, *l*, terminating with a small orifice, or jet, depending on the size of the pipe in which it is enclosed, is fixed as represented, and when it is required to exhaust the gas, a current of high-pressure steam is caused to enter the pipe, *l*, which issuing from the jet, passes in the direction of the horizontal arrows, at the same time drawing in or exhausting the gas, which flows as indicated by the arrows placed at angles to each other.

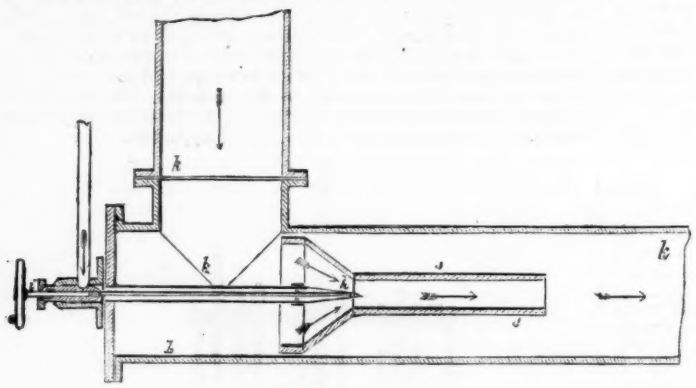


FIG. 2.

Fig. 2 represents the apparatus as ordinarily employed; *h* is the steam-jet attached to the steam regulator or stop-valve, *i*; the pipe conveying the gas, is represented as an elbow, the passage of the gas descending being indicated by an arrow; the small pipe introduces the steam, which rushes rapidly through the pipe, *j*, at the same time exhausting the gas.

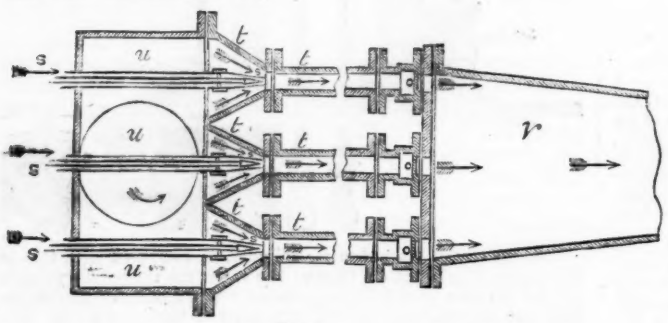


FIG. 3.

Fig. 3 represents an apparatus suitable for large works, for it appears that the action already described is materially reduced when the induction-pipes are much increased in size. For extensive establishments, therefore, an apparatus as represented, having three steam-jets, *s s s*, with their corresponding regulators and induction-pipes, *t t t*, is required. U is the inlet-pipe, *v* the outlet; the gas and steam passing as indicated by the arrows. Further, in order to adapt the apparatus to varying productions, each of the induction-pipes is provided with a slide-valve, *o*, so that each jet, with its induction-pipe, forms a separate, complete, and independent exhauster, which can be used either singly or in conjunction with the others. To convey some idea of the size of the apparatus employed, an induction-pipe, 3 feet long and 4 inches in diameter, has been found sufficient to exhaust 50,000 feet of gas per hour, against a back pressure of 13 inches of water, and maintain a steady exhaust of 2 inches within the hydraulic main. The inventor has also an arrangement whereby the supply of steam is controlled in direct proportion to the production of gas.

Fig. 4 is a vertical transverse section of steam condensing scrubbers recently erected in a large gas-work where the system is about to be thoroughly carried out. The throttle-valve, *h'*, has been introduced to provide against any inequality of current that might possibly arise from unequal resistance in the scrubbing medium, which consists of wood shavings, this material being chosen as presenting the largest area for the action of the water. The rings,

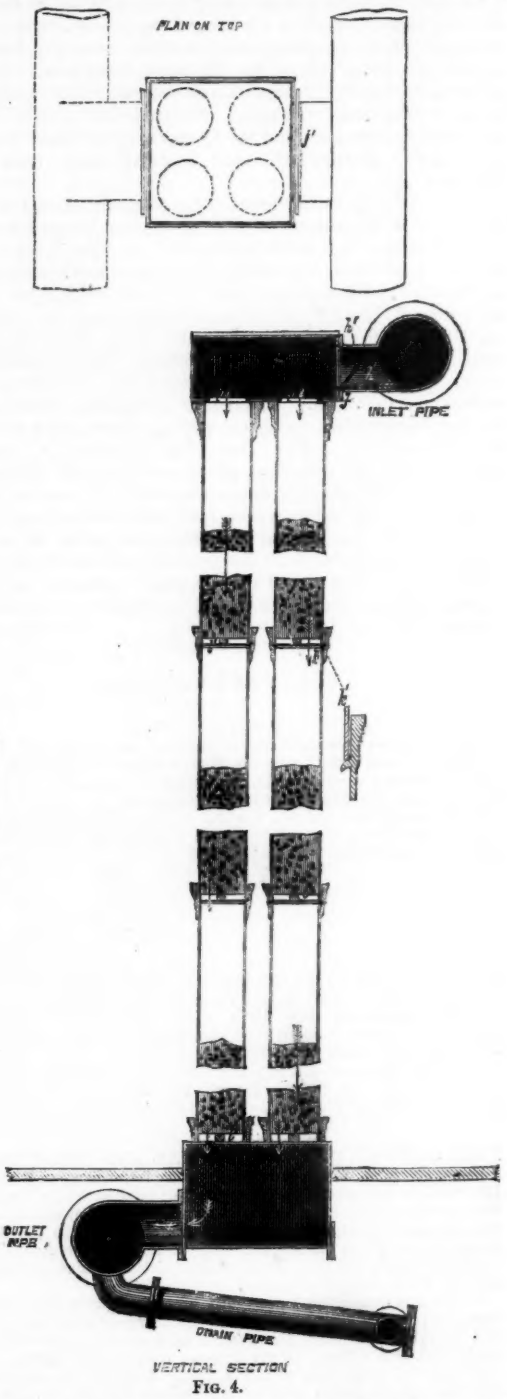
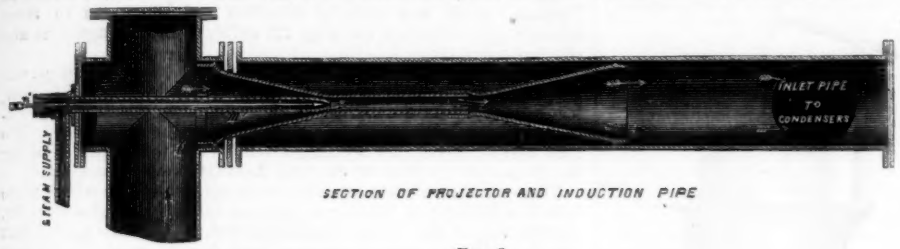


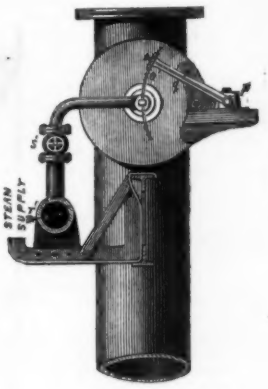
FIG. 4.

i, at the top of the pipes, are set exactly level with each other, and the ledges, *j'*, in the inlet branches of the main, are also set nearly

level, having only a very slight declination from the general inlet of the set. These rings and ledges are intended to secure a uniform trickling of the first condensed vapour into each box and pipe. The downward projection of the rings, as well as the drip-projection, *k*, at each joint of the columns, serve to direct the liquor on to the shavings, and prevent it from following the interior surface of the pipe. The drip and projections also support crosses, *l'*, of wood or iron, on which rest the shavings. There is no special provision made for the renewal or cleansing of the scrubbing material, for no such necessity is anticipated.



SECTION OF PROJECTOR AND INDUCTION PIPE



END ELEVATION

FIG. 5.

Fig. 5 shows the projector, *m'*, and induction-pipe, with their fittings to be used in working fig. 4. The traversing motion of the regulating stop-valve, *n'*, is produced by the lever, *o'*, in form of a section of a screw-thread, attached by the crank, *q'*, to the shaft, *p*, which is actuated by the steam-governor. This shaft is intended eventually to work six jets belonging to as many double sets of primary and steam condensers; *r'* is the main steam-pipe. The stop-valve, *s'*, is kept full open, except when the scrubber is to be thrown out of action.

In order to condense the steam, and render it available for absorbing the ammonia from the gas, Mr. Cleland passes the steam and gas into a condenser, which may be surrounded with water, for the purpose of more rapidly acting on the vapours, or into an air condenser of thin wrought metal, so that the heat may be radiated with all promptitude.

The extreme simplicity of the arrangement, the absence of noise during its action, the small cost of the apparatus, the limited space it occupies, and the nominal expense of wear and tear, are all strong recommendations to its use, and these advantages are further augmented by the combination of an exhauster and wahser in one and the same vessel. But here the thought would suggest itself that, although the apparatus might be highly efficient as an exhauster, yet, through an excess of steam, its properties as a washer might be highly prejudicial, inasmuch as the ammoniacal liquor might be rendered too weak either for sale or manufacture—a question of paramount importance at the present time, when the value of this residual is so well appreciated. This theoretical objection is answered by the experience of two or three years, during which period the steam exhauster has been in use. The observations of the inventor, moreover, seem to have been forcibly directed to this particular point, for, in describing the action of condensation, he says: "A portion of the steam spray or cloud continues floating on with the gas, even when cooled to ordinary atmospheric temperature, with greatly increased power of dissolving ammonia, and is only rapidly deposited as water when brought into contact with solids;" and respecting the strength of the ammoniacal liquor, Mr. Cleland states that the quantity and quality for commercial purposes has been fully maintained, and, further, that when necessary he experiences no difficulty in obtaining this from 10° to 15° Twaddel. For the most effective working, high-pressure steam is preferable, which can be readily understood on account of the small quantity of extra heat therein, as compared with its increased force.

In our opinion, the invention possesses the elements of success, and recently we were credibly informed, from other sources, that a similar apparatus has been applied on an extensive scale in several works in Germany, not only for exhausting gas, but also as a means of revivifying the oxide of iron in the purifiers without removal. For the latter purpose the cover of the purifier about to be operated upon being removed, a current of air is sent through the foul oxide by means of the steam-jet, when it is again ready as a purifying agent.

The process is repeated in the purifiers until the material becomes too compact and prevents the free passage of the gas, when it is removed and reduced into a granulated state previously to being again used. We do not mention this method as a novel means of revivifying the oxide, as the principle was employed many years ago, but for the purpose of demonstrating the efficacy of the apparatus as an exhauster or propeller of air or gas.

Various other methods of constructing exhausters have been adopted, some differing so slightly from those already described as to require no mention; others again, as the blower, similar to that used in the blast-furnace, have been employed with doubtful success, and there are others, possessing more or less merit, which we have not space to describe.

We now enter on the methods of working exhausters and their effects. As already stated, the deposit of carbon, particularly at high heats, is greatly increased by excess of pressure within the retorts, resulting in the deposition of the richest constituents of the gas therein, consequently the quality of the gas produced is materially diminished, its quantity affected, and other inconveniences are experienced.

To obviate these evils, and to ensure successful operation, the exhauster, under some conditions, is indispensable. With this machine all pressure upon the retorts can be entirely removed, but how far this is consistent and necessary will be presently shown. In illustration of the importance of the apparatus, let us suppose a work having, say, 24 inches of pressure (water being always understood) on the retorts, by no means uncommon in works having telescopic gasholders. Under these circumstances, with high heats, the deposit would be very rapid; but if the pressure be reduced to, say, 1 inch, then the deposit of carbon will be comparatively insignificant, the yield of gas will be increased about 10 per cent., and its quality will be at least equal, if not superior, to that obtained without the exhauster.

On the other hand, when the pressure on the retorts is limited to about 4 or 5 inches—by no means uncommon in well-constructed works where there are no telescopic gasholders—then the utility of the exhauster becomes doubtful, and in our opinion the slight advantage derived therefrom under these conditions is not equivalent to the interest on the capital invested, and the expenses of fuel, labour, and wear and tear attending its use.

Hence, with heavy pressure on the retorts, the exhauster is of the first necessity, as it reduces materially the quantity of carbon deposited therein, and by the absence of this non-conducting material, an economy in the fuel for carbonizing is effected, it reduces the loss by leakage arising from unsound joints, imperfectly luted mouthpieces, and defective retorts, and a larger yield of gas is consequently obtained from the coal. The greater the pressure, the more important become the functions of the exhauster, but when the former is reduced as stated, then the utility of the latter is questionable.

The exhauster is always placed between the condenser and scrubber, and when the breeze-box is employed, perhaps it is better that the latter should precede the former, and in combination therewith there should be one or more pressure-gauges in direct communication with the hydraulic main. In some large establishments, for the more perfect surveillance of the operations of this apparatus, an exhaust register is connected thereto. This instrument is similar to the pressure-register, and to it is attached a paper each day, on which is recorded the amount of exhaust during every period of the 24 hours, and any accidental increase or decrease of this, if only momentary, is faithfully indicated.

The pressure on the hydraulic main, however, does not indicate the pressure on the retorts, which must depend on the seal of the dip-pipes; for if we suppose the combined pressure to be, say, 24 inches, and the seal-pipes to be 4 inches, on removing 20 inches of this pressure the gauge communicating with the hydraulic main would indicate zero, or "level gauges," but there would still exist a pressure of 4 inches on the retorts; and by further exhausting, so that the gauge would indicate 1½ inch exhaust, then there would remain only half an inch pressure on the retorts. This is a point where considerable liability to error exists, as many engineers only take into account the pressure in the hydraulic main, which, as shown, is deceptive. The better method is to adjust the dip-pipes to the seal desired (say 1 inch), and work the exhauster to zero.

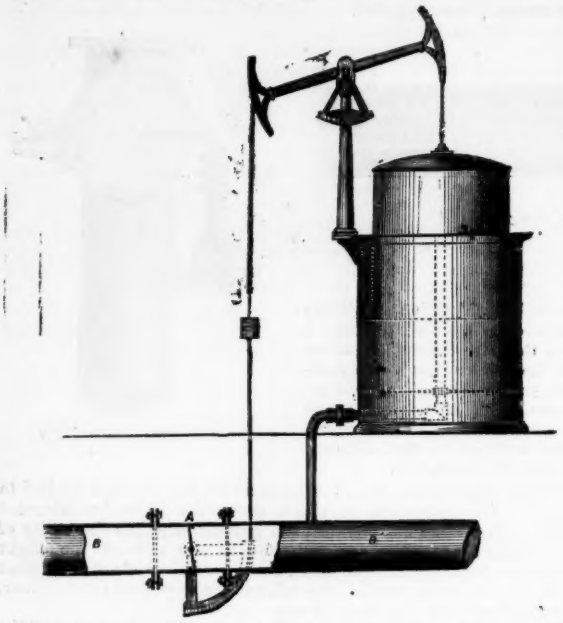
Mercurial pressure-gauges, although sometimes useful, should never be applied in connexion with the exhauster, as they are not sufficiently delicate for the purpose; water-gauges, or the exhaust register, are alone reliable.

The irregularities in the production of gas, together with the uncertainty of the action of the steam-engine, occasioned by the increase or decrease of pressure in the boiler supplying, render an automatic means of controlling the operations of the exhauster indispensable. This object was formerly accomplished by means of a bye-pass and valve, the latter being in connexion with a gasholder, counterbalanced to the pressure required, and the latter, being filled by any excess of pressure, opened the valve of the bye-pass. Thus the exhauster always worked at the same speed, although sometimes, as a matter of course, performing unnecessary work, as it acted on the gas without producing any effect, exhausting, as it were, the same gas over and over again.

The more modern exhaust-regulator differs materially from the foregoing, and one of the best of these is that manufactured by Messrs. A. Wright and Co., Westminster, represented on the following page.

This apparatus consists of a small gasholder, suspended by a curved lever in a suitable cast-iron tank, supplied with water to the desired height. The holder is counterbalanced by weights to the pressure required, and the rod carrying the weights is continued and attached to a quadrant, to which is fixed the axle of the throttle-valve, A, the axle working in a stuffing-box, placed on the main. Communication is made by a pipe, as shown, between the interior of the

gasholder and that portion of the main-pipe marked B, so that any variation of pressure at that point influences the position of the gasholder, and controls the throttle-valve.



In some cases the throttle-valve of the steam-engine is connected with the regulator. By these simple means the speed of the exhauster is made to correspond with the quantity of gas produced, so that the pressure in that part of the main marked B′ is always uniform, thus avoiding the intermixing of air with the gas, and the other evils attending excessive or insufficient exhaustion.

Another kind of exhaust regulator is that invented by Mr. C. Hunt, of which a drawing is here given.

This invention consists in such an improved arrangement of a throttle-valve as to constitute the apparatus to which it is applied a governor or regulator, the valve being operated upon by means of a gasholder, which is actuated by the pressure of the gas. Instead of fixing the lever or radius arm of the valve on the outside of the chamber on which the valve works, as heretofore, and attaching it to the spindle which carries the disc or throttle, by which the motion of the lever is communicated, the arm is fixed inside the valve-chamber, and, by preference, upon the disc or throttle. The pipe which ordinarily conveys the outlet gas, or gas which has passed the valve to the gasholder, is, in this arrangement, placed in the centre of the tank of the gasholder, and is connected to the top of the valve-chamber immediately over the end of the lever or radius arm farthest from the disc or throttle. A rod or chain passing down the pipe connects the lever to the crown of the gasholder in a similar way to that by which the cone of an ordinary gas-governor is suspended. No stuffing-box is required for the spindle, and in some cases it is preferred to substitute for the spindle steel centres, upon which the disc or throttle is accurately balanced and turns freely. The governor is adapted both for controlling the amount of exhaust applied in the manufacture, and to regulate the supply of gas to a district.

Mr. Everist, of Kidderminster, patented an exhauster governor or regulator in 1868, which consists of a circular metal tank or covered case, having an orifice in the centre of the bottom plate, through which rises to somewhat less than half its height a pipe, which is connected to the outlet of the exhauster. In the top plate of the case an orifice is also cast, and over this is affixed a pipe in connexion with the inlet of the exhauster. Within the case, and over the pipe first mentioned, a metallic bell or gasholder-shaped vessel is suspended by a rod working through a stuffing-box in the cover, and attached to a chain, which passes over a wheel on the outside of the case. The chain terminates in a rod whereon counterbalance weights are hung. In the sides of the bell two, three, or more graduated angular apertures are formed. These openings may be made either in the plain sides of the bell or recesses constructed in it, especially for the more easy passage of the gas. By this arrangement, as will be seen, the inventor dispenses with throttle or other valves, and proposes to control the supply by means of the angular openings in the sides of the gasholder.

The combined self-acting bye-pass and compensator of Messrs. Laidlaw, which was recently described and illustrated in these columns (see JOURNAL for Aug. 12, 1873), is also an ingenious and effective contrivance.

In the JOURNAL of Nov. 4, 1873, a description, with drawings, was given of a simple arrangement invented by Mr. Nelson, of Glasgow, for overcoming the fluctuation of the gauge in the pumping exhauster through the gas being kept back by the slide-valve. We have here space only for recalling attention to the paper read by Mr. Nelson at the West of Scotland Association on the subject.

There are few subjects connected with gas lighting on which there is such a difficulty of forming an opinion as with the exhauster, for, on reflecting on the various kinds described, we should suppose that the gasholder and tank, having the least friction, would be the best suited for the purpose; but, after years of experience, this was condemned. The friction of Grafton's, at any slight increase of velocity, was highly objectionable, and it is not surprising that its use was discontinued. The piston and cylinder being so universally employed in the construction of the steam-engine, would suggest this as the best form for the exhauster, but this is not confirmed by practice. To judge from theory, we should be led to suppose that the friction attending Jones's and Beales's exhausters would be such as to prohibit their use, but practice has demonstrated the contrary; and the fact of the latter apparatus being so extensively employed alike in the very largest establishments, as in those of limited capacity, is the strongest of all arguments in its favour.

The perfection of these apparatus consists in their doing their duty with the smallest amount of fuel. In England this is not so much a consideration, but in localities where coal is often three or four times the average price here, then fuel becomes a very important question, and the choice of the most economical exhauster a matter for serious reflection.

(To be continued.)

Legal Intelligence.

MANSION HOUSE POLICE COURT.—WEDNESDAY, OCT. 21.
(*Before the* LORD MAYOR.)

EUPION GAS COMPANY'S SHARES.

For the fourth time, the hearing of the charge against *Joseph Aspinall, Samuel Gurney Fry, George Parkyns Knocker, John] Saunders Muir,* and *Charles Knocker,* of having conspired together to defraud members of the Stock Exchange of a large sum of money, was resumed this day.

The LORD MAYOR, at the outset of the inquiry, called the special attention of the prosecution to a clause in the Act 24 & 25 Vict., cap. 96, which said that whosoever, being a director, manager, public officer, or member of any body corporate or public company, should, with intent to defraud, destroy, alter, mutilate, or falsify any book, paper, writing, or valuable security belonging to the body corporate or public company, or make or concur in the making of any false entry, or make or concur in omitting any material particular in any book of account or other document, should be guilty of a misdemeanour. He went on to say that, looking at the books of the company in this case with his mercantile knowledge, they seemed to have been falsified from beginning to end, including the banker's book and the banker's account, with other documents. There was an entry in the capital account, for example, showing that the witness, Mr. Parratt, had paid £500, the truth being, as he stated in evidence, that he had never paid a farthing. Again, two other witnesses were represented in the account to have paid respectively £800 and £50; whereas, according to the evidence they had given, they never paid a farthing, With those facts before him, he wanted to know how the Act of Parliament was to be construed.

Mr. POLAND said he was obliged to the Lord Mayor for calling attention to the subject. It had not been lost sight of by the counsel for the prosecution, and when the whole of the evidence was put before the bench they would have to ask that the defendants should be committed for trial. Among the overt acts charged was the falsification of entries in the books of the company, and in the end the defendants would be charged with a general conspiracy to obtain a settling-day on the Stock Exchange, and to get up the company in question with a view to defraud stockbrokers. The company, as would be seen, originated in fraud and continued in fraud. The whole enterprise, in fact, was a juggle from beginning to end.

Mr. LEWIS, on behalf of Mr. Aspinall, took entire exception to the remarks of the Lord Mayor, which he thought the circumstances did not justify.

The LORD MAYOR repeated that the books were a fiction from beginning to end.

The evidence was then continued. Two or three witnesses were called, who stated that they had signed applications for shares at Mr. Aspinall's request, and had executed blank transfers; and after some further evidence the case was again adjourned, the defendants being admitted to bail as before.

CAMBRIDGE GAS SUPPLY.—At the meeting of the Cambridge Town Council on Friday last, a report from the gas inspector (Mr. W. E. Pain) to the Gas Test Committee was read. It was as follows:—"8, Sidney Street, Cambridge, Oct. 10, 1874.—Gentlemen,—Since my report in May last, I have tested the illuminating power of the gas, by the apparatus fixed in the Guildhall, on four separate occasions, on three of which it was below the standard of 14 candles. The observations were as follows:—June 24, 13·46 candles; Aug. 14, 13·58 candles; Sept. 11, 12·33; Oct. 2, 14·52. The purity of the gas has been good, the average of the sulphur testing giving only 14·44 grains of sulphur per 100 cubic feet. The jet photometer and the mercurial governor were fixed in August, and experiments taken twice daily are entered into the book you provided for the purpose. The governor necessitated an alteration in the fixing of the pressure-gauge, which is now worked by an independent supply, the pipe coming direct from the main without passing through a meter. The pressure has been good on all occasions, and the observations were entered in the photometer register.—(Signed) WALTER E. PAIN." The committee observed that the readings at the Guildhall, corroborated elsewhere, were exceedingly unsatisfactory, and recommended that the foregoing should be sent to the directors of the gas company, calling their attention to the defective state of the illuminating power; and this course the council agreed to. Mr. Pain, who was in attendance, stated that the average of the jet photometer readings for September was 13·7; and from October 1 to 20 14·9.

Miscellaneous News.

SHEFFIELD UNITED GASLIGHT COMPANY.

The Ordinary General Meeting of Shareholders was held at the Cutlers Hall, on Monday, the 19th inst.—Mr. F. T. Mappin in the chair.

The following report and statements of account were presented:—

As will be seen by reference to the accounts for the half year ending the 30th of June last, which your board have now the pleasure of laying before you, recourse must again be had to the reserve-fund, in order to pay the maximum dividend.

Such dividend amounts to		£20,941	8 6
And the half year's profits being only		18,266	14 0
The amount to take from the reserve-fund will be		£2,674	14 6

After the above appropriation the reserve-fund will still stand at £36,400 11s. 5d.

The dividend recommended by your board is as under:—

Dividend on £135,000 class A stock, after the rate of £10 per cent. per annum		£6,750	0 0
Dividend on £209,053 10s. class B stock, after the rate of £10 per cent. per annum		10,452	13 6
Dividend on £99,700 class C stock, after the rate of 7½ per cent. per annum		3,738	15 0
Total		£20,941	8 6

Since the last meeting, Mr. Herbert Unwin has resigned his appointment of engineer of the company, and Mr. John Young (who is at the present time manager of the works at Hull, belonging to the British Gaslight Company, Limited) has been appointed to that post. Mr. Young will assume his duties so soon as he can be released from his present situation, which your board hope will be very shortly after, if not by the time for, the meeting to which this report will be presented.

Your board have every reason to expect that the new offices will be completed by the close of the present year.

You will be asked to sanction the borrowing, on mortgage or bond, of £20,000, in addition to the £20,000 authorized to be borrowed at the meeting held on Oct. 17, 1873, and of which latter sum £19,400 has been already raised.

The three directors who retire are Mr. Mappin, Mr. Hutchinson and Mr. Shaw.

The two former offer themselves for re-election; but your board regret that Mr. Shaw (who has been one of the elected directors ever since the year 1859) has stated it is his intention to retire.

Your directors unanimously recommend that Mr. Henry Clifton Sorby should be appointed to supply Mr. Shaw's place at the board.

Dr. *Capital Account, for the Half Year ending June 30, 1874.* *Cr.*

Class A stock, fully paid up	£135,000	0	0	Land, buildings, parliamentary, and other expenses, works, and machinery (including mains to June 30, 1855)	£386,043	7	11
Ditto B ditto ditto	209,053	10	0				
Ditto C ditto ditto	99,700	0	0				
12,937 new ord. £10 shares (2nd issue), £2 per share paid up	25,874	0	0	Mains from June 30, 1855	61,050	11	8
Amount raised on mortgage	19,400	0	0	Meters	25,903	18	3
				Balance	16,029	12	2
	£489,027	10	0		£489,027	10	0

Dr. *Revenue Account.* *Cr.*

Half year's gas, meter, and other rents, due this day, including amount arising from the sale of coke, tar, waste lime, ammonia water, gas fittings, and work done	£78,799	6	2	Half year's expenditure in the production of gas.	£59,834	3	1
				Paid mortgagees & bankers for interest during the half year	698	9	1
				Balance	18,266	14	0
	£78,799	6	2		£78,799	6	2
Balance brought down	£18,266	14	0	Dividends payable Nov. 1, 1874	£20,941	8	6
Deficiency to be taken from reserve-fund, Nov. 1, 1874.	2,674	14	6				
	£20,941	8	6		£20,941	8	6

Maximum price of gas, 3s. 1d. per 1000 feet.

Dr. *General Balance.* *Cr.*

Balance of revenue account	£18,266	14	0	Ledger balances, and accounts owing to the company	£38,429	19	2
Ledger balances, and accounts owing by the company	37,350	18	11	Stores in hand	13,575	4	6
Balance of capital account	16,029	12	2	Balance due from bankers	19,641	4	0
				Balance due from cashier	0	17	5
	£71,647	5	1		£71,647	5	1
Reserve-fund, invested Dec. 31, 1873					£40,566	15	4
Amount transferred to revenue, May 1, 1874					2,345	7	5
					£38,221	7	11
Interest to June 30, 1874					853	18	0
					£39,075	5	11

The Chairman, in moving the adoption of the report, said: You will all remember that at the half year ending Dec. 31, 1873, we had to take from our reserve-fund £2345 to enable us to pay our usual dividend. At the half year ending June 30, 1874, we had again to trench on our reserve-fund to the extent of £2674. These are large sums, no doubt, but when we look at other companies who have advanced their maximum price for gas, we see that they have been almost invariably compelled to have recourse to their reserve-fund, and they vary from £1000 up to £26,163 for the half year. One company has had to take from its reserve-fund this latter large sum in order to enable it to pay its usual dividend. Your directors did not think it prudent to advance the price of gas, and the policy they have adopted has, I think, been a wise one. The customers, no doubt, have been satisfied with the treatment they have received at the hands of the company when the maximum charge per 1000 of 3s. 1d. has not been advanced during the exceptional time through which we have passed. I may mention two items that are of very large amount. The company's coals, I find, cost them during the last six months £5671 more than in the corresponding period of 1873; so that you see that these two items added together amount to £7915, which will account in a great measure for the deficiency of profits which would enable us to pay our ordinary dividend. We are not alone in this respect. The Phœnix Gas Company paid for coals during the first six months of 1874, £24,776 more than it did in the corresponding six months of 1873, and it received for coke £8617 less during the same period of this year than it did in that of last. Now, gentlemen, we are often told that the extra cost of coals does not enter as an element in to the cost of making gas, and that the residuals in such a case make up for the cost. I think the experience of this company and that of the one I have just mentioned prove this to be a fallacy, and the statement, no doubt, is made by persons who have had no experience and no knowledge of it for some object. I noticed that in one of the local papers a paragraph appeared a few days ago to this effect: "Mr. Wilkinson reports that the illuminating power of the gas in Sheffield last week was as low as 16·08 candles;" and it further states, "From the miserable light shed upon us as we write, from three burners, we presume the power is equally low this week." I think this is not fair treatment. The gentleman who wrote the paragraph ought to have stated the mean average during the same month, it being 17·24; but he takes the lowest test made by the corporation, or rather by the gentleman who tests for the corporation. The highest test during the month of September was 17·97, and the lowest 16·08. Our Act compels us to supply 15-candle gas, and the lowest we have supplied is 16·08. I may further state, for your information, that we have many towns quoted as supplying gas of high quality, but we are not informed at the same time that these towns test by Sugg's burner—a burner the Sheffield Gas Company is not permitted to use—and this makes an improvement in the quality of gas of 1½ candles. Possibly you may have seen that the result of working several of the gas undertakings has been very unfortunate. I will mention one that has come under my observation—namely, the Glasgow Corporation Gas-Works. The cost of these works by the old company up to the time when they were taken by the Glasgow Corporation was £320,000, and the corporation have spent since that time in repairs and enlargements £363,500. Their loss during the past two years has been £40,109. When we compare the position of this company with others, I think we have cause to congratulate ourselves on the position we have maintained. I think we have supplied our consumers with a good article at a low price, and if any of us travel to other towns and compare the light we have here with what we find there, we shall find that whatever may be said of us we give a very excellent quality of gas. With these few remarks I move that the report of the directors be approved and entered on the company's minutes, and that a copy of the resolution be forwarded to each shareholder.

Mr. James Walker seconded the resolution. He considered they owed a great debt to the directors for the satisfactory manner in which the concern had been conducted. As long as ever Sheffield stood, the noble building erected as the company's offices would stand as a memento in commemoration of what the directors had done.

Mr. J. Wilson said the chairman had accounted satisfactorily for the difference in price of coal and the difference in the sums realized for the sale of coke, but, comparing their present balance-sheet with the one of the last year, he found that the total expenditure in the production of gas this year was £7421 less than in producing gas during the half year ending Dec. 31. That was a large item, especially when they considered that the profits on the price of gas for the half year were only £44 more than last year. The directors must have been buying coal at considerably less than last year, and it was wonderful to him that the profits should only show an increase of £44 for the additional capital called up. It necessitated a draw on the reserve-fund about equal to the increase of capital. It seemed to him rather a strange thing, and made him think that the management had not been as efficient during the last half year as in times past. Public companies were now looked on with suspicion, and the necessary facts he had quoted seemed a strange anomaly. It was peculiar that the expenditure in the cost of gas had been £7421 less and the increased profit realized had been but £44. It was not for him to say what the reason was. He had been asked whether the management was deficient. Was there any reason for the retirement of the company's engineer? He was not aware of it. The comparing of one period with another—the comparing of the present half year with the corresponding half of the last would hardly apply in this case. He could buy coals now much cheaper than he could nine months ago. Comparing it with last year, he did not think the thing stood as favourably as he could have expected. He was glad that the directors had pursued the policy of not raising the price of gas. He thought this course a wise one. Latterly it had been trying times for the directors of gas companies as well as for the directors of other companies, and they had great reason to be thankful for the dividends which had been realized.

The Chairman, in replying to Mr. Wilson's remarks, said the usual and fair way was to compare the corresponding half of one year with the corresponding half of another. Were they to compare the half year just past with the one ended Dec. 31, 1873, they would find that in the latter named a much larger quantity of gas was made and sold, consequently the profits might be expected to be larger. Their expenditure in making gas during the half year ended Dec. 31, 1873, was £67,255, and during the past half year £59,834, making a reduction in the expenditure of £7421. The income for gas had been £85,980 in the half year ended Dec. 31, 1873, and during the past half year it had been £78,799, making a difference of £7101. They could not make the same profit if they sold £50,000 worth of gas as if they sold £60,000 worth. It was not to be supposed that they could therefore, on that score, be considered to have done fairly. Mr. Wilson remarked that coal could now be bought cheaper than nine months ago. He could quite understand that, and so could the Sheffield Gas Company, and they were now buying coal at much less prices; but during a portion of the first half of this year they had to pay the highest price for coals, and were glad to get them. During the other portion of the half year they had got them at considerably less prices, and during this half year they had been buying them at still less prices and of better quality. In reference to the engineer, all he could say was that, after some little difficulties with the officials, Mr. Unwin, the late engineer, sent in his resignation, and it was accepted by the directors. Then, with respect to Mr. Young, the engineer now stationed at Hull, they examined his credentials, and saw what he had done before. They were careful in knowing what he had done before, and, having ascertained that, they felt he was the best man who had applied to them for the position, and the directors engaged him. They thought Mr. Young would have been present that day, but they had received a telegram from him saying that he could not come until Tuesday.

The motion was adopted, as also was one declaring a dividend of 10 per cent., payable on the 2nd of November next.

Mr. F. T. Mappin and Mr. H. Hutchinson were re-elected directors, and Mr. H. C. Sorby was also appointed to a seat at the board.

A vote of thanks to the chairman concluded the proceedings.

METROPOLIS GAS SUPPLY.

Metropolitan Board of Works.—At the meeting on Friday last, a letter was read from the London Gas Company, stating that they are desirous of having a weekly inspection made by one of their servants of their main in the subway of the Victoria Embankment, in addition to the board's supervision; and requesting that an appointment may be made to receive a deputation from the company, to confer with the board as to whether any, and if so what, further security could be taken to prevent any accident which might occur from an escape of gas into the subway; and also representing that if an additional gas-main is allowed to be laid in the subway it will interfere with the proper inspection and repairs of the company's main. The communication was referred to the Works Committee.

Metropolitan Municipal Association.—At the meeting of this association, on Tuesday last, the honorary secretary, Mr. Jas. Beal, was requested to prepare a statement as to the financial result of the operation of the Metropolis Gas Act of 1860, and the City of London Gas Act of 1868. The consideration of giving notice for a gas bill for next session to meet the competing position of the Metropolitan Board of Works, the City corporation, and the gas companies, was deferred till next meeting. It was stated by the honorary secretary that he had reason to believe the public had gained £600,000 per annum since the passing of the gas Act of 1860, and that the gain by the City of London Gas Act since 1868 was £625,000, being a saving greater than had resulted to London from any previous legislation promoted by a voluntarily supported association, and this without the co-operation of the Metropolitan Board of Works.

METROPOLIS WATER SUPPLY.

Major Bolton's report for the month of September states that the condition of the river at Hampton, Molesey, and Sunbury, where the intakes of the West Middlesex, Grand Junction, Southwark and Vauxhall, Lambeth, and East London Companies are situated, was very good throughout the month. The highest flood state of the river at Hampton during the month was 4 inches above the

(6 feet) summer level, and the lowest 4 inches below. At Ditton the state of the water in the river was good during the month. The Chelsea Company is now the only one whose intake is below Hampton Court Bridge, and is affected by the river Mole, the outflow of water from which during flood is of a highly objectionable character. The highest state of the flood water at this place was 2 inches above, and the lowest 1 inch below summer level. The highest temperature of the water during the month was 64°, and the lowest 58°, while the highest temperature of the air at the same place was 75°, and the lowest 52°. These observations were made daily at 9 a.m. The rainfall during the month was 2·24 inches. The water at the Thames intakes was generally very good during the month. The Kent Company now give a constant supply of water to a portion of their district (principally in Deptford and Plumstead) including about 5450 houses. The New River Company are now giving constant supply to part of Edmonton parish, consisting of Southgate and Winchmore Hill. The company have given notice to the Local Board of Edmonton to erect the requisite number of fire hydrants on the mains in that parish, which mains have been provided with outlets at every 100 yards. Two engines at Betstile of 12-horse power each have been brought into use since last month. The Lambeth Company are about to erect additional engine power both at Ditton and Brixton works, a 24-inch main, 3 miles in length, is being laid to convey more water from Brixton to the centre of the lower district, and a new reservoir at Norwood will be shortly commenced to serve the intermediate level between Rock Hill and Selhurst. This company are giving constant supply by means of stand-pipes in a number of courts and alleys. The filtering of the Metropolitan water supply has been lately much improved by the extension of the area of the filters, and by a slower rate of filtration being observed. 2½ gallons of water per square foot of filter-bed filtered each hour will be 540 gallons per square yard of filtering area each 24 hours, and it is desirable that this rate of filtration should not be exceeded.

EAST LONDON WATER-WORKS COMPANY.—Notices have been given by this company to the Metropolitan Board and the corporation of a further extension of the constant supply system from and after the 15th of February next. The district affected by this notice is contained within imaginary lines drawn along the respective centres of High Street, Whitechapel, of Leman Street, of Dock Street, of Upper East Smithfield, of Glasshouse Street, of Royal Mint Street, and Mansell Street.

BURNLEY CORPORATION GAS-WORKS.

At the Meeting of the Burnley Town Council on the 7th inst., the gas accounts for the year ending the 30th of June last were presented. The Gas Committee brought up a report in which they recommended that the price of gas should be fixed for the twelve months ending the 30th of September, 1875, at 3s. 4d. per 1000 cubic feet, being a reduction of 4d., and that the charge for supplying, lighting, cleaning, &c., the public lamps should be at the rate of £3 per lamp per annum, instead of £3 10s. It appears that the cost of coal last year averaged about 19s. per ton, and that the present contract is 15s. 4d.

An amendment to the recommendation of the committee was moved and carried by a majority of 14 to 6, by which the price of gas to private consumers for the next year was fixed at 3s.

The following is an abstract of the accounts submitted and approved:—

Dr. Revenue Account, for the Year ending June 30, 1874. Cr.

Manufacture of gas—				Sale of gas, per meter,			
11,855 tons of coal and cannel, including carriage, unloading, and trimming	£10,892	5	7	100,574,800 cubic feet	£16,631	0	10
Salaries and wages	2,044	18	5	Public lamps	2,227	5	2
Purification, including labour	329	14	9	Rental of meters	997	6	4
Maintenance of works	1,774	16	3	Residual products—			
Distribution—				Coke £3,179 3 1			
Maintenance of mains, &c., and labour	530	11	1	Tar and water 1,128 16 6			
Salaries and wages of officers	316	17	2	Spent lime 45 19 8			
Repairs and renewals of gas-meters	19	4	7		4,353	19	3
Lighting and repairing public lamps	263	9	8	Mortar and sundries sales	108	2	11
Rents, rates, and taxes	411	16	5	Rents of mill, warehouse, and cottages	153	11	3
Management—				Profit on fittings	15	13	10
Salaries, offices, clerks, and collecting	348	6	9	Discounts and abatements	8	15	1
Stationery, stamps, &c.	52	4	5				
Law charges, insurances	52	12	2				
General charges	138	7	5				
Total expenditure	£17,182	4	8				
Interest and depreciation	3,413	3	1				
Surplus profit, being balance	3,900	6	11				
	£24,495	14	8		£24,495	14	8

Capital Account.

Loan from borough department, June 30, 1874	£31,305	13	6	Cost of plant to June 30, 1873	£77,203	6	3
Loan from Commissioners of Public Works	1,350	0	0	Expended this year	1,485	14	11
Gas deposits, in hand	1,477	15	0	Stock of cannel, coal, & stores	7,845	7	5
Sundry creditors	1,704	3	1	Amount due for gas & fittings	5,016	19	1
Amount of depreciation-fund, June 30, 1873	22,540	4	0	Sundry debtors	20	19	6
Added this year	1,930	1	7	Doubtful debts account	257	0	6
Balance of surplus account, June 30, 1873	31,235	3	7	Balance in treasurer's hands	2,981	18	5
Profit this year	3,900	6	11				
	£95,443	7	8				
Less deficiency in municipal department	632	1	7				
	£94,811	6	1		£94,811	6	1

BRISTOL PUBLIC LIGHTING.

A Special Meeting of the Corporation and Sanitary Authority of Bristol was held on Tuesday, Oct. 20, the MAYOR presiding, at which the Sanitary Committee presented the following report:—

Your committee report that the contract for lighting the public lamps in the city and county of Bristol being about to expire on the 29th of September last, your committee advertised for tenders for lighting with gas and maintaining the public lamps in the said district for three years, and received only one offer—viz., from the Bristol United Gas-light Company. Your committee were not satisfied with this offer, and therefore entered into negotiations with the directors of the company with a view to obtain better terms; and they have made a provisional agreement, subject to your approval, for lighting the public lamps on terms of which the following are the heads:—The contract to be for three years, from the 29th of September, 1874. The gas to be supplied shall be not inferior in illuminating power or in purity to that prescribed by the Bristol United Gaslight Company's Act, 1873. Main-pipes are to be found by the company, and laid down throughout the district. Service-pipes, to connect lamps with mains, to be provided and fixed by the company, as well as all stop-cocks and contingent apparatus, and to be paid for by the sanitary authority. Burners to be found by the company, and to be of such form and construction as will consume the stipulated number of cubic feet per hour of gas at the pressure at which it may be from time to time supplied by the company; and if it shall be found that the burners supplied by the company, or any of such burners do not consume the stipulated quantity, the company shall be liable to the penalties provided by the Gas-Works Clauses Acts, 1871, section 36—viz., 40s. for each default. Lamps, lamp-irons, and pillars are the property of the sanitary authority, and are to be kept in repair by the company, who are to paint the same with one coat of oil colour in each year. The company are to repair the glass when broken, and to keep the lamps clean to the satisfaction of the sanitary authority, and to deliver up the lamps in good order at the expiration of the contract. Situation of lamps is to be altered, additional lamps erected, fitted, and supplied by the company, at the cost of the sanitary authority. Burners are to be exchanged for larger or smaller sizes when required, the exchanges not to exceed 50 in any year. Time of lighing and extinguishing lamps to be in accordance with the time table now in force. In case of accident (except civil commotion) either wholly or partially cutting off the supply of gas, the company to provide good and sufficient oil lamps, to give a light equivalent to the light which would be yielded by the stipulated burners, and the company are to keep a sufficient number of such lamps in readiness for emergency. Penalty of 5s. for every lamp not lighted in accordance with the time table, or which shall be extinguished before the stipulated time, or for not repairing broken glass withing 24 hours of notice given to the company, or for not cleaning the glass according to the contract. The company to be bound in the penal sum of £10,000 for the due and faithful observance of the contract. Prices to be paid include every contingent expense, except the provision of lamps, lamp-irons and pillars, services and fittings, and are as follows, for the first year of the contract. The prices to be paid to be as follows:—For a lamp, fitted with a bat's-wing burner, consuming 7 cubic feet of gas per hour, £5 10s. per annum; ditto, 5 cubic of gas, £4 4s.; ditto, 4 cubic feet of gas, £3 15s.; ditto, 2½ cubic feet of gas, £3; ditto, fitted with a single-jet burner, consuming 1 cubic foot of gas, £1 15s. The contract to be revised after the first and second years of the contract, so that if there shall be a reduction in the price of gas to the private consumer, the charge to the local authority shall be reduced two-thirds of that reduction. Your committee further report that the part of the price per lamp charged for lighting and extinguishing, repairs, painting, &c., is 17s. 6d. per lamp per annum. This price is stated by the company, and is recorded in their books to be as nearly as possible the actual cost. The number of hours during which the lamps are required by the time table to be buring is 3613 per annum. If all lamps are alight for the full period of the table, it is evident that some of the lamps must be burning for a certain time before and a certain time after the hours prescribed by the table; and the company state that on the average one hour per day per lamp must be calculated to cover this extra time necessary for lighting and extinguishing. If this be admitted (and the company are firm in insisting on this allowance) the total number of hours during which a lamp would be alight on the average per annum would be 3978. Applying these figures to the prices quoted, it appears that the price to be charged to the sanitary authority will be 3s. 4½d. per 1000 feet; the present price to the private consumer generally is 4s. per 1000 feet—the lowest price charged being 3s. 10d. per 1000 feet. The price paid for gas under the late contract was estimated by the company at 2s. 9d. per 1000 feet. Your committee recommend that a contract be entered into on the terms of which the above statement is an outline. The gas company claim as their property certain fittings and apparatus fixed to 1213 lamps in the ancient city, and 92 in the district of the united parishes of St. James and St. Paul, erected prior to 1840. The matter is being investigated, and if it should be found that the fittings are the property of the gas company, your committee recommend that they should be authorized to purchase them at a price to be agreed upon.

Alderman BAKER, in moving the adoption of the report, said with regard to the question of extinguishing the lamps at an earlier hour, he was quite sure that the public would not be satisfied to depend upon the light of the moon, which a single black cloud might obscure, to say nothing of the deep shadows which were thrown in the narrow streets of the city, and which would really leave the streets in utter darkness, so that he could only characterize such a suggestion as mere "moonshine." Having referred to the condition that during the three years, if there were any reductions made to the public, the sanitary authority were to have an allowance of two-thirds of that reduction, whatever that might be, he observed of the late contract, which had been taken at 2s. 9d. per 1000 feet, that the company must have lost money owing to their supplying it at that low rate, notwithstanding the increased cost of manufacture. The principal question at present between the company and the city was as to the number of hours charged for per day, especially relative to one hour reckoned for lighting and extinguishing the lamps, so as to have all lamps alight at the time prescribed in the time table. The company asserted that though working in the most economical way with their present staff they would not save anything of that hour per day. They were quite determined, and would not give way. The only alternative would be arbitration, but he did not think the corporation would do well to go to arbitration on the question of saving half an hour per day in the consumption of the gas, more especially seeing that the gas company were making experiments for obtaining a more rapid method of lighting their lamps by rod instead of by ladder. In concluding, he expressed his satisfaction with the price now arrived at—viz., 3s. 4½d., which was a considerable reduction upon what the public were paying; a reduction, however, which he thought was only fair, seeing that the company were saved the trouble of collecting, &c. He thought the committee had made the best bargain they could make. In reply to a question with reference to the fittings of certain lamps which the company claimed to be their own property, it was asserted by the company that they had provided those fittings, and had never been paid for them. But the sanitary authority said that, although they might never have been paid for them directly, these fittings had constantly been changed and renewed, so that the original fittings were not there at all. They thought, however, that it was fair matter for discussion.

Mr. H. NAISH, in seconding the motion, said with regard to the additional hour, small as it might seem, it would add 10 per cent. to the cost of the contract. He thought the gas company clearly entitled to a portion of that, for they could not light and extinguish the lamps without some allowance of time, but he thought the time was too long. However, as Alderman Baker had said, he considered that the committee had made the very best bargain they could.

Alderman GREEN thought that there really was nothing for the council to do but to accept the tender. The gas was in the hands of a private company; they had the monopoly, and could exact what terms they liked. The council lost the chance years ago of securing the means of supplying the city with gas. He had advocated the purchase by the corporation of the Clifton Gas Company, but it became amalgamated with the Bristol Gas Company. They heard occasionally out of doors of a second company being established, but that was quite out of the question. It was true that what the city of Bristol paid for lighting the public lamps would pay the interest at 5 per cent. on a very large capital, and they might, if they chose, start a gas company. But that, he thought, was not likely to be done, for it involved many considerations—the laying of mains and other things which would lead to considerable inconvenience. It had been urged that the corporation should purchase the gas company, but he believed it would be unwise. With the strides science was making it was not improbable that before long some means of producing light or illuminating power, otherwise than gas, might be produced. For his own part, his conscience was perfectly clear, for when the Clifton Gas Company was being assigned to the Bristol Gas Company, he urged as strongly as he could upon the house the desirability of purchasing the Clifton works, and making them the nucleus of a company for lighting the city.

Major BUSH said he did not think they had been liberally treated by the gas company, and though it might not be convenient for the company to go into the comparative cost of gas in other large cities and towns, he maintained that it was the duty of the sanitary authority to have laid such before them. In many other places the cost per lamp was less than in Bristol, where the price of coal was 30s. per ton, and he should like to hear whether or not it was true that at the present moment the gas company had entered into contracts for the supply of coal for a considerable period at 8s. per ton. If that was true, he submitted that it was a question which ought fairly to be taken into consideration in determining the lighting contract. It had been said that the price of coal was so high last year that the production of gas had resulted in a loss to the company, but that argument did not hold good for the previous two years of the period during which the contract for lighting the public lamps extended, as coal was not then so high. At all events, they knew that their dividend had been the same for the last three years. The Corporations of the City of London and Liverpool had determined to take the matter into their own hands, and he hoped there would be no occasion for taking such steps in Bristol, but that there would be an honourable understanding, and every pains would be taken to reduce the price. He gave the deputation from the sanitary authority credit for having done the best they could for the city, and he was but expressing the sentiments

of a large number of ratepayers out of doors who were dissatisfied with the present arrangement.

Mr. J. D. WESTON, as a director of the gas company, wished to make certain statements which he considered should be known. He thought that the public generally were under a great mistake as to the feeling prevailing at the Gas Board in relation to the corporation and the public. Knowing as much as he did of the proceedings of the gas company, he might say that they regarded surplus profits as belonging to the public—the directors only working in the interest of the shareholders within the powers of the Act of Parliament. The directors had exercised every economy they possibly could practise in order to bring about a diminution in the cost of gas, and he should like the council and the public to know that, taking their capital together, they were only able to pay 7 per cent. Their capital was divided into two portions—the old capital paying 10 per cent.—the other, which was much the larger capital, only paid to the shareholder about 5¼ per cent., thus, taking the whole together, they paid upon a capital of £400,000 or £500,000 a dividend of 7 per cent. It had been, all through those negotiations, the purpose of the gas company to endeavour to adjust prices fairly as between the city, the corporation, and the company. During the existence of the last contract there was only a difference of 7 per cent. as between the price to the city and to the public—by the public he meant the private consumer. They were only charging the sanitary authority a price equivalent to 2s. 9d., when they were charging the general private consumer 3s. But, on the present occasion, considering that coal had already gone down in price, and that there was great reason why they should make greater allowance than they did on the former occasion, they had taken off from the price charged to the private consumer a discount equal to 16 per cent. Now, if they were to sacrifice more in giving in their price to the sanitary authority they would have to impose additional burthens on the private consumer. The case appeared to him perfectly plain. In considering the price to be given in to the sanitary authority, they had to debit them with the consideration of the fact that the gas company kept the gas in during the night, and that they lost a considerable quantity of gas from waste in consequence of the pressure it was necessary to keep on during the night for lighting the public lamps. On the other hand, they had to place to their credit the fact that they had no service-pipes to supply; that they were very large consumers, and gave them no trouble in the collection of debts, and besides that there was no risk. With regard to comparing Bristol with other towns, he said let them take the case of Birmingham. They were now charging 3s. 4d. per 1000 feet, and allowing a discount of 10 per cent.; but he could tell the council that during the six months ending June the gas company of Birmingham had, upon a capital of £600,000 or £700,000, only made a profit of £1200. Surely sensible men and business men would not be governed by inspirations gathered from them. He did not think that the gas company in this city obtained credit for the public spirit he considered they deserved, for, as one of the directors, he could say that they had as much the thought of the public before them as the interest of the shareholders. They were struggling to cheapen gas, knowing that in serving the public they were serving themselves. Every director was a large consumer of gas, and was therefore interested in its cost. They could gain nothing by their shares beyond what the Act of Parliament gave to them, but they could gain by cheapening the price of gas. It would always be the purpose of the directors to reduce the charge for gas at the earliest moment they could, but when it was remembered that during the last half year they had been obliged to withdraw £20,000 from their reserve-fund, it was quite clear that such a course could not continue.

Mr. TOWNSEND said he thought that it would be wise, during the running of the contract which had now been entered into, to consider very seriously the desirability or otherwise of the corporation purchasing the gas-works. It must be well known that several corporations in various parts of the kingdom had lately considered that question, and that some of them had entered into negotiations for the purchase of the gas-works. Mr. Weston had referred to Birmingham, and he held in his hand a report of the Birmingham Town Council held in March last, at which terms were agreed upon for the purchase of the gas company, and he was informed that though the price to be paid was a large one, they estimated a profit to the town of about £15,000 or £16,000 a year after charging a very moderate sum to the consumer. The case of the city of Manchester was still more remarkable, though probably not a parallel one, for the gas company had been for some time in the hands of the corporation. There, at the close of the year 1873, when the financial accounts were made up, there appeared, after charging a moderate price to the consumer and for the public lamps, a gross profit of £63,603, of which sum £16,602 was carried to the credit of the Improvement Committee. So that it was not always a losing speculation. In conclusion, he remarked that there was one point which, in fairness to the company, ought to be brought out, but which had not hitherto been mentioned, and that was that in Bristol they had a much better light than in some other towns.

Mr. WHITWELL said he was informed that, some time ago, the Glasgow Corporation bought the gas-works in that city, and they proceeded to raise the price and to lower the quality, and they had not yet managed to pay anything like a reasonable interest on the capital. He very much doubted whether it would be a profitable thing to purchase the gas-works in this city.

Alderman BAKER, in reply, remarked that none of those who acted upon the deputation from the sanitary authority had the slightest interest, either directly or indirectly, in the gas company, and their only object had been to get the best bargain they could for the city. He very much questioned whether corporations could manage commercial undertakings so well as private companies.

The motion was then put to the meeting, and carried with but one dissentient —Major Bush.

WEST OF SCOTLAND ASSOCIATION OF GAS MANAGERS.

The Sixth Quarterly Meeting of this Association was held in Musselburgh on Thursday, Oct. 8—Mr. W. SMITH, Helensburgh, vice-president, in the chair.

The minutes of the last quarterly meeting at Dumfries, and the minutes of subsequent meetings of committee, having been read and confirmed,

Mr. DAVID YOUNG, gas-works, Dalkeith, was duly proposed and seconded for membership, and unanimously admitted.

The CHAIRMAN then said that the opening remarks, which formed the next business in the programme, would have to be omitted on the present occasion. It was not often that a society such as theirs was deserted by its president, and, being quite unexpectedly called on to fulfil his duties, he was placed in rather an awkward predicament, having had no time to make any notes to lay before the members of the association. But the subjects in which they were interested were now so much talked over that there was scarcely anything really new to bring forward, and, perhaps, in the circumstances, the best plan would be to call upon Mr. Young to proceed with the reading of his paper.

Mr. W. YOUNG (Paisley) read the following paper on

THE ABSORPTION OF THE ILLUMINATING CONSTITUENTS IN COAL GAS BY THE HEAVY HYDROCARBON OILS.

A short time before the death of my late brother-in-law, Mr. Cusiter, of Dalkeith, he handed me for revisal a rough draft of a paper, or rather a number of notes of experiments which he had made on the absorption of the light-giving constituents of coal gas by means of the heavy hydrocarbon oils, and stated that he intended laying a paper on the subject before a gas managers meeting. God, in His all-wise providence, thought fit to remove him before he could fulfil those desires; and, as the papers were left in my hands, I felt it a sort of duty to fulfil his wishes, and I have from them, and from other experiments I have made, compiled the following paper. It far from pleases me, as I have not had the necessary time to devote to it. I therefore trust you will be as lenient as possible with your criticisms.

You are all aware that ordinary illuminating coal gas is a very complex body, varying in character according to the nature of the coal from which it has been produced, and also the heat at which the distillation has been conducted; but, in all cases, it consists essentially of non-illuminating gases, illuminating gases, and suspended vapours of volatile hydrocarbons.

The present paper takes into consideration the solvent or absorbing power of the heavy hydrocarbon oils for those suspended vapours and illuminating gases, also the practical application of the same to the manufacture of gas. Mr. Cusiter's attention was first directed to this subject in the winter of 1868, when experimenting with glycerine as a substitute for water in gas-meters. After having experimentally and practically determined both the evaporative and freezing properties of glycerine, and satisfied himself that its drawbacks more than counterbalanced its advantages, he turned his attention to several other liquids which might be suitably applied to the purpose. One of the liquids which were tried was mineral oil, of ·840° specific gravity. On charging the meter with this oil, and throwing it into action with 28-candle gas, he was surprised to find that the illuminating power was reduced to 14 candles, and the condensation by bromine from 11·8 to 5 per cent.; with 35-candle gas, the illuminating power was reduced to 16·1 candles, and the condensation by bromine from 17·4 to 6·2 per cent. During the course of last winter he repeated the foregoing experiments, and made several additions thereto. Those additions included paraffin spirit of ·768° specific gravity, the distillate of crude paraffin oil of ·810° specific gravity, ordinary burning oil of ·820° specific gravity, refined mineral oil of ·840° and ·860° specific gravity, and blue oil of ·895° specific gravity, all at 60° Fahr. The coal gas was passed through those fluids at a temperature of 50° to 55° Fahr. In every case, the action of the fluids on the illuminating power of the gas was appreciable, but was greater with the denser oils. The heavy oils, or those requiring higher temperatures for their ebullition, condensed the illuminating constituents in the gases with the greatest facility. By passing 28-candle gas through the paraffin spirit, of ·768° specific gravity, at a temperature of 60° Fahr., the result was *nil;* when the temperature was reduced to 50° Fahr., there was a loss in illuminating power of 5 per cent.; and when the temperature was raised to 70° Fahr., there was a gain of 7 per cent. By passing the same gas through either of the heavy oils, the loss of light was equal to 65 per cent., and by agitating the gas and heavy oil together, the light-giving constituents were almost entirely removed, and the gas after treatment consisted of light carburetted hydrogen, hydrogen, and carbonic oxide, and gave very little light indeed.

The following table shows the increase by measure of the undermentioned oils, after being saturated with the light-giving constituents from coal gas passed through them:—

Name of Oil.	Specific Gravity.	Initial Quantity. Fluid oz.	After Saturation. Fluid oz.	Increase per Gallon. Fluid oz.	Increase per Cent.
Once-run oil . .	·810	20	22·5	20·0	12·5
Burning oil . .	·820	20	22·7	21·6	13·5
Heavy oil. . .	·840	20	23·0	24·0	15·0
Lubricating oil .	·860	20	23·5	28·0	17·5
Blue oil . . .	·895	20	23·8	30·4	19·0
Olive oil . . .	·914	20	23·8	30·4	19·0

Attention was next directed to the separation of the absorbed light-giving constituents from the saturated heavy oils. To accomplished this, the mixture was placed in a still, and heated gradually to a temperature sufficiently high to cause the absorbed volatile matter to pass over into a condenser. The nature of the distillate was found to vary very much, being dependent upon the nature of the gases operated upon, and more especially the temperature at which the gases had been distilled from the coal; but in all cases, the distillate consisted of condensable and non-condensable or gaseous hydrocarbons. Gas made from coal at a low temperature, similar to that used for the destructive distillation of coal, &c., for paraffin oil, gave a distillate of 34 per cent. permanent gas, and 66 per cent. of liquid hydrocarbons, very similar in composition to light paraffin or petroleum spirit, as shown by the undernoted table of boiling points:—

Distillate from Coal Gas made at Low Temperatures.

Specific gravity, at 60° Fahr., ·706·3°.

Distils	10 per cent.	at	128 degs.
,,	50½ ,,	,,	176 ,,
,,	82 ,,	,,	212 ,,
,,	94½ ,,	,,	248 ,,
,,	100 ,,	,,	300 ,,

Petroleum Spirit.

Specific gravity, at 60° Fahr., ·703.

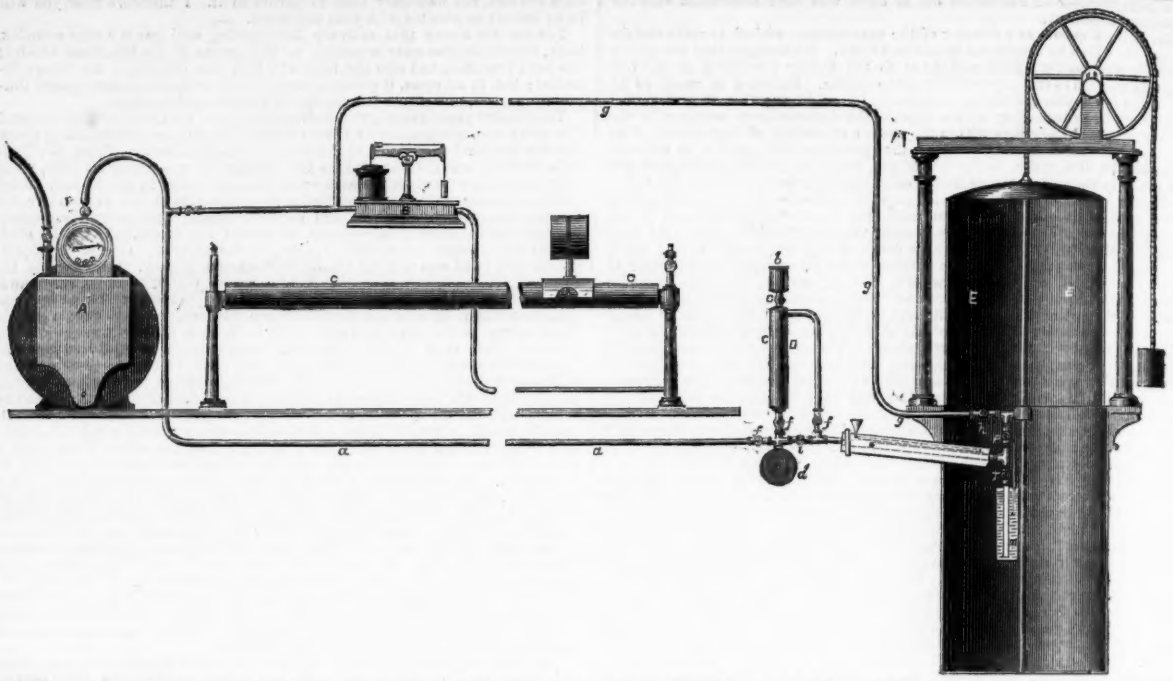
Distils	6 per cent.	at	138 degs.
,,	50 ,,	,,	176 ,,
,,	84 ,,	,,	212 ,,
,,	93 ,,	,,	248 ,,
,,	100 ,,	,,	280 ,,

On the other hand, gas made from the same coal at a high temperature gave a distillate consisting of 36 per cent. permanent gas and 64 per cent of liquid hydrocarbons, having a specific gravity of ·852°, and very much resembling the most volatile portions of the distillate of ordinary coal tar, and consisted principally of benzole, combined with a number of other volatile hydrocarbons.

There are various practical applications of the subject of this paper to the manufacture of illuminating gas, but it would extend it to too great a length to take notice of more than one of them—viz., the facility with which we are enabled to examine the nature of the illuminating constituents of a gas.

You are all aware that coal gas, when newly made, may have a very high illuminating power; but that on being exposed to a low temperature in the gasholder, or by being made to travel through a long length of pipe, the illuminating power is very considerably lowered, sometimes to the extent of from 10 to 15 per cent. You are also aware that the gases from the various coals and other gas-making materials are not all alike in this respect, some coals giving gases remarkable for their permanency, and others, again, the reverse way. This want of permanency is caused by the difference in the nature of the light-giving constituents, some gases being principally indebted for their illuminating power to hydrocarbon vapours; others, again, to gaseous hydrocarbons.

Hitherto, the only means we have applied to the examination of those hydrocarbons has been the bromine test, and no doubt this is a ready and very excellent way of arriving at their mere volume; but bromine absorbs alike both gaseous and liquid hydrocarbons, and forms with them chemical compounds which we cannot readily separate or analyze; this test, therefore, gives us no idea of their nature, whether gaseous or otherwise. Now, it is evident from the nature of the distillates recovered from the heavy oils, after being saturated with the light-giving constituents of coal gas, that these hydrocarbons, on being absorbed by the heavy oils, are not changed or chemically combined with them, as is the case when bromine, chlorine, &c., are used, and when true chemical compounds are formed; but that they are only absorbed or dissolved in a similar way to ammoniacal gas in water, and can again be separated by simple distillation in exactly the same condition as they were in before being removed from the gas. We can, therefore, by employing a heavy hydrocarbon oil in an arrangement similar to that shown in the annexed diagram, very readily examine the illuminating constituents of a gas.



The gas to be examined is first tested for its illuminating power in the ordinary way; it is next passed by the pipe, *a a*, to the arrangement, D, resembling a miniature scrubber, consisting of a reservoir for the heavy hydrocarbon oil, *b*; a chamber, *c*, filled with small marbles; a receiver, *d*, for containing the saturated heavy oils; and a Liebig's condenser, *e e*, for condensing the volatile hydrocarbons. The cocks, *f f f* F, are first opened, causing the gas to pass up through the chamber, *c*; at the same time the stop-cock, *o*, is opened, and oil is allowed to flow from the reservoir, *b*, over the marbles contained in the vessel, *c*. This presents a large surface of oil to act upon the gas and absorb the light-giving constituents. The denuded gas then passes on to the gasholder, E E. So soon as the portion of gas to be examined has passed through the arrangement, the stop-cocks, *o f f f* P, are closed, and the stop-cock, *h*, opened, making the gas to pass through the pipe, *g g*, and through the governor, B, to the photometer, where the illuminating power is determined. The loss gives the value of the illuminants absorbed by the heavy oil. The stop-cock, *h*, is now again shut, and the contents of the gasholder noted. The stop-cocks, T P *r*, are then opened, the Liebig's condenser charged with cold water, and heat applied to the receiver, *d*, containing the saturated heavy oils. This causes the volatile matter absorbed from the gas to pass over into the Liebig's condenser, when the liquid portion is condensed, and falls into the graduated glass tube, *k*, and the non-condensable or gaseous portion passes on to the gasholder. As soon as the distillation is complete, the receiver, *d*, is cooled, and the contents of the gasholder again noted. The increase is the volume of absorbed gaseous illuminants. The stop-cock, *i*, is again shut, and the absorbing arrangement, D, is thrown into action, as before, and as much denuded gas passed into the gasholder as makes up the original bulk. The absorbing arrangement is again thrown out of action, and the illuminating power of the mixed gases determined. The gain in illuminating power shows the value of absorbed gaseous illuminants. The same process may be repeated with the condensed liquid portion by opening the stop-cock, T, and, during the passage of the gas, volatilizing the liquid contained in the graduated test-tube, *k*, by applying heat to the enclosing vessel, *m m*, containing a saline solution, and at the same time carefully noting the boiling points and volume of the vapours added to the gas, we can, from the vapour tension, calculate whether the gas will be permanent or not.

To enable you the better to understand the foregoing remarks, I beg to draw your attention to the recapitulation of the observations to be made in conducting an examination of a gas by this arrangement:—

First Observation.

Illuminating power of 5 cubic feet of newly made gas . . say	30 candles.
Quantity of gas passed through absorbing apparatus, as registered by experimental meter . . . . . say	10·00 cub. ft.
Quantity received into gasholder	9·12 „
Gives loss of volume by absorption	0·88 candle.

Second Observation.

Illuminating power of 5 cubic feet of denuded gas . . . say	12·5 candles.
This gives loss in illuminating power (= value of hydrocarbons absorbed from 5 cubic feet of gas)	17·5 „

Third Observation.

Contents of gasholder after testing for illuminating power, say	6·87 cub. ft.
Gives quantity used in trial	2·25 „
Contents of gasholder after revolatilizing absorbed gaseous hydrocarbons	7·21 „
Increase (= volume of volatilized gaseous hydrocarbons) . .	0·34 „
Denuded gas, previously removed in testing illuminating power, replaced in gasholder	2·25 „
Total contents of holder, representing gas with gaseous hydrocarbons	9·46 „
This gives illuminating power of 5 cubic feet of the gas . .	19·90 candles.
This gives net illuminating power of gaseous hydrocarbons absorbed from 5 cubic feet of the gas	7·40 „
This gives also net illuminating power of liquid hydrocarbons absorbed from 5 cubic feet of the gas	10·10 „

Fourth Observation.

Note quantity of liquid hydrocarbons in graduated test-tube . . . . . say	37·5 fluid grs.
Gives to 140° Fahr. 10 fluid grains evaporated volume of vapour	·18 cub. ft.
140° to 160° „ 8 „ „ „ „	·13 „
160° to 190° „ 15 „ „ „ „	·18 „
190° to 220° „ 4·5 „ „ „ „	·05 „
This gives bases upon which to calculate permanency at various temperatures.	

In the above description of the method of applying heavy oil to the examination of the light-giving constituents in coal gas, no notice has been taken of corrections for barometrical pressure, temperature, &c., as, in speaking to a body of practical men, I have taken this for granted as understood.

And now, gentlemen, in conclusion, there are still many important points connected with the subject of this paper, but I have already taken up too much of your valuable time, and will defer them till some future meeting.

Discussion having been invited,

Mr. KEY (Accrington) said that the ideas and facts enclosed in Mr. Young's paper were entirely new to him. It was a strange fact that gas lost so much volume by passing through this hydrocarbon oil. The general belief was that if they passed gas through hydrocarbon oil, it would increase its illuminating power, whereas the fact appeared to be that it very much decreased it. He wished to know if, on applying heat to the receiver underneath the absorbing apparatus, and thereby revolatilizing the absorbed illuminating constituents, the original volume and illuminating power were made up.

Mr. YOUNG replied that that depended on the nature of the illuminating constituents which had been absorbed from the original gas by the heavy oils. If the absorbed hydrocarbons were gaseous, or had a very low boiling point, the original volume and illuminating power would be made up, and the gas would, to all intents and purposes, be a permanent one. But, on the other hand, if it happened that the illuminating power of the original gas was due partly to naphthaline or other hydrocarbon having a high boiling-point, then both the original volume and the illuminating power would be decreased in consequence of the boiling point of naphthaline and such hydrocarbons being so near that of the heavy oils used for absorbing the illuminating constituents from the gas that they both distilled and condensed together. The volume of the vapour and the illuminating power due to the naphthaline would, in consequence, be detracted from the original gas.

Mr. KEY: Suppose you were taking, say, 15-candle gas, and passing that through the same apparatus, using petroleum spirit, would it not increase instead of diminishing the luminosity?

Mr. YOUNG: That depends altogether on the boiling point of the spirit employed, and the temperature at which the gas is passed through the apparatus. I think that one of the experiments quoted in this paper was the passing of gas through paraffin spirit. The experiment I refer to was that in which 28-candle gas was passed through paraffin spirit of ·768 sp. gr., at a temperature of 60° Fahr., and the result was *nil*; but when the temperature was reduced to 50° Fahr., there was a loss in illuminating power of 5 per cent. On the other hand, on raising the temperature to 70° Fahr., there was a gain of 7 per cent. You will observe that this spirit has the peculiar properties of absorbing or decreasing the illuminating power at low temperatures, and at higher temperatures increasing it.

Mr. KEY: I suppose it would depend on the temperature and the nature of the hydrocarbon employed in this apparatus whether it increases or detracts from the luminosity?

Mr. YOUNG: At ordinary temperatures, with very heavy oils, there was little difference in the absorbing power by small changes of temperature, but, at higher temperatures the absorbent action ceased, and, as the boiling point was approached, vapour would be given off into the gas which would very much increase its luminosity; but these vapours would not be permanently suspended, for, on cooling, the gas would deposit them again as a liquid.

Mr. KEY observed that the arrangement seemed to be so simple, consisting as it did of an ordinary testing-meter, a gasholder, &c., with the new absorbing apparatus attached, that any gas manager could fit it up on his own premises, and readily examine the gas in the manner explained. The fact that a per centage of nearly three-fourths of luminosity was lost in passing gas through this hydrocarbon oil was certainly very peculiar, and sufficient to make them wonder. The subject was one of very great importance, and, as gas managers, they ought for themselves to try and see the phenomenon worked out.

In reply to other questions from Mr. KEY,

Mr. YOUNG said that the practical view to take of the subject should be the advantage it gave them in the choice of their coal and other gas-making materials, by selecting those which gave gases of a permanent nature at low temperatures, and rejecting those which did not. It was also of great advantage in enabling them to examine the gas produced from coal carbonized at various temperatures; it being a fact that different coals required very different temperatures for their perfect carbonization. He would like to have proceeded further in the direction indicated by Mr. Key, into the practical application of this paper; but as part of the matter was the subject of a patent not yet completed, he was sorry that he was thus precluded from any further discussion on that matter.

Mr. W. MACLEOD (Glasgow) said that his ideas had hitherto been the reverse of those stated by Mr. Young. As a chemist, he wished to hear Mr. Young's

opinion as to whether the new pneumatic gas would be permanent at a distance from where it was manufactured.

Mr. YOUNG replied that the permanency of this pneumatic gas depended altogether on the nature of the volatile hydrocarbons, whose vapours are employed to give luminosity to the air. First, as to their composition, for the greater the quantity of carbon in proportion to hydrogen, the smaller will be the volume of vapour required to give the desired amount of light. Secondly, their boiling or evaporating point, for on this depends the quantity which can be permanently suspended as vapour at any given temperature. He would try to convey to their minds the law which regulated the suspension of vapours in air, when they would be better able to judge as to the value of the new air gas schemes. If we take a barometer-tube, fill it with mercury, and place it in a vertical position, carefully noting the point at which it remains stationary; then pass a little water into the bottom of the tube, it will ascend to the surface of the mercury and become partially evaporated, causing the column of mercury to sink to a certain extent, which depression will exactly indicate the volume of vapour given off at the temperature at which the experiment is made. If the tube be then exposed to a further increase of temperature, the mercury will be correspondingly further depressed, in consequence of the water giving off a larger volume of vapour, until at 212° Fahr. it will depress the mercury to the extent of 30 inches, or, in other words, boil. If instead of water we use petroleum spirit, or other hydrocarbon having a boiling point of, say, 140° Fahr., we shall find that at similar temperatures the depression of the mercury is much greater; for it was ascertained by Mr. Dalton that the force of vapour from all liquids is the same for the same variations of temperature, reckoning from their boiling points; or, in other words, water at 182° Fahr. (or 30° below boiling point) would give off vapour to the extent of depressing the mercury 15 inches. Petroleum spirit at 110° Fahr. (or 30° below boiling point) would depress the mercury to the same extent. It is found that the vapours from volatile liquids diffuse themselves through air or any gas to exactly the same extent as they do in a vacuum. Therefore, by observing the per centage depression of the mercury column at various temperatures by any volatile liquid, we can ascertain the exact quantity of its vapour which can remain permanently suspended or diffused through air at these temperatures. There is no doubt that an illuminating gas perfectly permanent at ordinary temperatures can be made by suspending the vapours of very volatile hydrocarbons in air. Petroleum spirit, with a boiling point of 140°, can at 32° Fahr. remain permanently suspended to the extent of from 6 to 8 per cent. in air, giving a very fair luminosity. The only other matter to be considered is—can sufficient of such a very volatile hydrocarbon be got to supply the demand?

The CHAIRMAN said the subject was a most important one, and he had no doubt that most of the gas managers present would be taken by surprise by the results of Mr. Young's experiments.

Mr. KEY mentioned that in his district he had recently noticed a number of apparatus fitted on the outlets of gas-meters, and filled with oil; the object being that the gas, after it was measured, might be enriched by passing through the oil to the consumers burners. Seeing that some of the lighter hydrocarbon oils had the property of absorbing the illuminants at low temperatures, might these carburizers not be a source of loss instead of gain?

Mr. YOUNG said that it was a fact that the gas would be improved and the luminosity increased by using some of the lighter petroleum spirits, and if proper care and attention were used in selecting these spirits the gas would no doubt be improved; but these carburizers were something like the small household governors—they easily got out of repair from want of attention, and became a source of mischief. They should endeavour to make their gas so good that it would require no carburizing.

Mr. KEY stated that some months ago he was struck with the nice light he had observed across the border. He recommended the members of the association to supply every customer with proper burners, and to reduce the illuminating power of the gas. For Scotland the standard was from 25 to 32; while in England, although it was as low as from 14 to 18, there were few complaints of bad gas.

On the motion of the CHAIRMAN, seconded by Mr. KEY, a vote of thanks was cordially passed to Mr. Young for his valuable paper.

(To be continued.)

ON THE CONDITION OF THE IMPURITIES IN COAL GASES OF HIGH AND LOW ILLUMINATING POWER.

By CHARLES R. C. TICHBORNE, Ph.D., F.C.S., M.R.I.A., &c.

In the years 1872 and 1873, I had an opportunity of trying some experiments in connexion with the condition of the impurities in gas of a high standard (20 candles). My first experments were instituted to see how far carbon was actually disseminated through the atmosphere from these gases, or whether a 20-candle gas would, as described by Professor Frankland, owe its higher illuminating power to the radiation of light from denser hydrocarbon vapours or from solid particles.* This inquiry, after a time, developed, as will be seen, into one of another character; but I will first detail my preliminary researches.

It is probable that the main increase in the illuminating power of gas is due to the causes specified by Professor Frankland, but it is equally certain that, in practice, solid carbonaceous particles are more freely disseminated from the gas of a high standard than from a low one, say a 16 candle, the conditions being exactly similar as regards burner and supply of air. This fact may be determined in many ways. In one of my experiments four small chambers were constructed for the relative and optical examination of the atmospheres resulting from the combustion of these gases by the electric or lime light. Two chambers are required for the examination of one light; and the two experiments with the different gases under examination were simultaneously performed.

Filtered air was introduced in one of the chambers, in which the gas was burning from an ordinary fishtail burner, and the products of combustion passed into the second, or dark chamber, through which passed a beam of bright light. It is very easy to arrange these compartments or chambers in such a manner that a comparative view of the results may be determined by the eye. The combustion of the gas must be regulated by watching the meters provided for the purpose of controlling the supply. It may be objected to such a mode of examination that the light impinging upon the clouds of heavy hydrocarbons would produce similar effects to solid carbon; but the carbon deposit can be virtually procured by placing cold plates of glass at stated distances over openings along the route of the escaping vapours. An arrangement was made by which cold water was allowed to flow at the back of the plates to keep them cool. These plates will reveal a slight deposit of carbon when examined by the electric or lime light, and from the relative examinations so effected by them, and the previous experiments, there could be little doubt that the high illuminating gas gave a greater deposit, *cæteris paribus*.

These experiments, however, were not followed up, because they gave no pronounced information. The results were not quantitative, and were only confirmatory, to a certain extent, of what our general observations have premised—viz., that 20-candle gas, as made practically in gas-retorts, will deposit carbonaceous matter more fully than 16-candle gas. This question, however, is outside the question of illuminating intensity, and is an accidental but an accompanying fact. From my experiments, I am of opinion that coal gas of the lowest standard, possessing any amount of luminosity worth mentioning, will show traces of this deposit when submitted to searching tests.

My attention was first attracted, in the winter of the year 1872, to the marked effect of the combustion-products of gas on some fabrics dyed with aniline colours, and from certain indications then perceived, the following investigations were instituted:—I determined to investigate the products of combustion from different gases possessing different illuminating powers, chemically and quantitatively—the gases to be burnt in as nearly as possible the same condition as we should use them in our ordinary consumption. And as in these experiments my object was to obtain extreme gases, or gases which would present extreme phases as regards their condition, I arranged to have two in use—one of a low illuminating power, obtained by passing the ordinary gas at my disposal through a given volume of spirit. The gas played through the spirit in a specially arranged vessel, and the results were remarkably uniform if the amount of spirit was regulated with each measure of gas. The spirit was found to be strongly impregnated with the hydrocarbons, and was rejected after each experiment. At the exit of the wash-bottle was arranged a short condensing apparatus of a simple nature, intended to eliminate as much as possible all liquids from the experimental gas. Even the spirit itself is, to a certain extent, found floating onwards, due to the attraction of liquids by miscible vapours. My gas with the high illuminating power was obtained by substituting the light petroleum hydrocarbons (boiling from 25° to 30° C.) for the spirit in the washing apparatus, using the same amount, and rejecting after each experiment as before.

From the slowness of the combustion, and the necessary complications of the apparatus, it was quite impossible in such experiments to determine the actual illuminating power of the actual gas performing the experiments; but when I say that the gas used in one set of experiments marked on an average 12 to 12½-candle gas, and that the carbonized gas marked on an average 21 candles, I think there is little question but that there was margin enough to allow of any slight fluctuations there might be in this respect in the original gas with which I was manipulating.

The experiments were put on at the same hour, and all performed under as like a condition of circumstances as possible. The gas, when burned in Letheby's apparatus, gave 0·41 grains of sulphur for each 10 feet, and may be considered as a fair specimen of a commercial gas.

The photometer used in these experiments was Bunsen's, with Letheby's modifications. Each observation was made with ten readings taken at minute intervals, and the average formed the determination.

From the unmistakable evidence of sulphurous anhydride ("sulphurous acid") found in a given sample of gas of a high illuminating power, determinations were instituted with regard to this substance, or rather, we should say, the condition of oxidation in which the sulphur molecule would be given off. It is hardly necessary to say that sulphur rarely passes to the burner as sulphide of hydrogen; if the gas-makers know their business, it is chiefly as sulphide of carbon that it exerts its deleterious influence. Let it be understood, however, that it is immaterial whether the sulphur is present as sulphide of hydrogen or sulphide of carbon; the products will be SO_2 or SO_3, sulphurous or sulphuric anhydride, according to the perfection of the combustion. The first action of heat upon bisulphide of carbon is to resolve it into its elements, carbon and sulphur, which are burnt, respectively, into carbonic acid and sulphurous anhydride, according to the following equation:—$CS_2 + 6O = CO_2 + {}_2SO_2$. Therefore we may consider that the combustion of bisulphide of carbon in coal gas is tantamount to the combustion of sulphur itself. It is generally stated that the result of the combustion of sulphur in atmospheric air or oxygen is sulphurous acid; but this is only partially right—in fact, in experiments performed for the purpose, I always find that a trace of sulphuric acid is formed, and that much more is formed in the presence of a large supply of oxygen, or in the presence of the lower oxides of nitrogen, which, it will be seen further on, may probably occur in coal gas.

Sulphuretted hydrogen burns very easily, and the combustion is generally attended with the production of free sulphur if there is an imperfect access of air, or if the gas is eliminated in large volumes; but such a decomposition is hardly likely to occur in coal gas.

The experiments were performed in Letheby's apparatus for the estimation of sulphur in gas. It was very convenient to apply the chemical examination intended to the products of combustion, and the object was not so much the estimation of the sulphur as to get a qualitative examination of the products of combustion. In these experiments 15 to 30 (generally 20) feet of gas were allowed to pass through the meter at the rate of 1½ hours to each foot of gas. The carbonizing or decarbonizing apparatus (as the case might be) was placed between the meter and the burner, and the products of combustion were mixed with vapour of ammonia, and, by a bent glass chimney, were conveyed into the ordinary large glass cylindrical receiver. In the preliminary experiments the ammoniacal vapour, used to fix the volatile acid, was introduced just below the burner, with the intention that it should be drawn through the apparatus by the strong draught produced by the combustion. It will be seen that another arrangement had to be adopted, owing to an unforeseen reaction. Two fluid ounces of distilled water were introduced into the receiver to assist and determine the condensation of volatile products, and the whole was supplemented by a very long tube, which condensed and brought back into the cylinder all the combustible products. The total amount of the sulphur in the gas averaged 4·16 grains per 100 feet, determined by precipitating the products with chlorate of barium ($Ba_2 C O_3$) in a hot solution.

Having estimated the total sulphur, the object we had in view was now to estimate the amount of sulphur eliminated from the burner as SO_2, and for this purpose a volumetric solution of iodine was used, each 100 c.c. of which represented 0·2 grain of sulphur or 0·4 grain of sulphurous anhydride.

The first experiments were performed with an Argand burner, the ammonia being introduced into the centre of the flame by a tube; hardly any evidence of sulphites could be found in the receiver, owing to the production of lower oxides of nitrogen. An ordinary fishtail burner was at this stage of the investigation substituted for the Argand burner, and the following were the results with a 21-candle gas:—

1. (10 feet) required 7 c.c. vol. sol. I.
2. (20 „) „ 8 „ „
3. (30 „) „ 10 „ „

When the products of combustion were acidulated with sulphuric acid previous to the estimation with the volumetric solution, indications were still there of the lower oxides of nitrogen, and, from the discordant results, it was self-evident that there was some cause of error. In fact, the diffusion of the ammoniacal gas was so rapid that part of its vapour was burnt at the expense of the flame under experiment. To remedy this, the ammoniacal gas was so arranged that it should enter the large glass cylinder just where the bent chimney conveying the products entered, so that the cylinder was always full of ammoniacal vapour, but there should not be any in the chimney, the draught being so strong that all the vapours are swept forward through the apparatus with some considerable impetus.

After this arrangement was effected, the experiments proceeded with considerable regularity, as will be observed from the following figures:—

30 feet required 35·5 c.c. vol. sol. I.
30 „ „ 32·5 „ „
30 „ „ 36·0 „ „

showing an average of 11·5 c.c. of the volumetric solution of iodine as being neutralized by the products of combustion of 10 feet. This represents 0·023 of S to the 10 feet, or 0·23 of a grain of sulphur eliminated as sulphurous acid to the 100 feet.

The experiments were repeated, but the gas was decarbonized by passing it

* *Vide* "On the Combustion of Hydrogen, Oxygen, and Carbonic Oxide under great Pressure."—Proceedings of Royal Society, vol. xvi., p. 419.

through the measured quantity of methylated spirit as detailed. At the conclusion of the experiments, the gas was found saturated with volatile hydrocarbons of the benzol series, and small quantities of hydrocarbons having a high boiling-point.

20 feet required 9·0 c.c. vol. sol. I.
20 „ „ 8·0 „ „
20 „ „ 11·5 „ „

Average of this gas, therefore, calculated to the 60 feet, only gave ·0095 grain of sulphur as given off in the form of sulphurous acid to each 10 feet.

To sum up these experiments as far as they have gone, we may state that one of the most important observations made consists in the fact that in a gas of a high illuminating power a very large proportion of the sulphur is eliminated as sulphurous acid, that in one of a low illuminating power a considerable portion will be eliminated as sulphuric acid. Another important phase of the combustion is that the ammonia, or such volatile compounds as aniline (if they exist in coal gas), will be converted into nitrous acid or some of the other low oxides of nitrogen.

The products of the slow combustion of ammonia would seem to be nitrate of ammonia; and ammoniacal gas and oxygen, according to K. Kraut, is entirely converted into that gas by a spiral of platinum wire. It is also probable that some bisulphide of carbon is retained by some of the fluid used in these experiments. This might account for the low amount of sulphur found in the relative experiments, but not for the great discrepancy in the two series of estimations.

As regards the relative therapeutical effects of sulphuric *versus* sulphurous acids, it might be said that the ultimate results would be the same because the sulphurous acid becomes gradually converted into the higher oxide. This is only true to a very limited extent; in fact, the sulphuric acid vapours are much more local in their effects, whilst the sulphurous acid is diffused at once through the apartment, and may be perceived, by virtue of its irritating effects upon the lungs, in any part of the room. It is probable that in the storeage of delicate goods they would be much more likely to be injured by the sulphurous acid, and, *ergo*, by the 20-candle gas, than from the emanations from 16-candle gas. I am of opinion, also, that there is more sulphide of carbon present in ordinary gas than is generally stated, and that it escapes all the ordinary processes of estimation. I must, however, reserve this point for another communication.

As regards the Letheby apparatus, it seems capable of performing many experiments having an important and useful bearing. Its great recommendation is that it submits the gas to a combustion similar to that which takes place in its daily use, and that, if more perfect combustion of the sulphur took place upon burning the gas with spongy platinum, as in Valentine's process,* it would not give the information we require in these special investigations.

The experiments embodied in this paper are not put forward as by any means complete, but they may be viewed as pioneers of a style of investigating which must be attended with some novel results, and must repay the experimenter. The presence of ammonia in the gas will determine the elimination of the sulphur as sulphuric acid.

NOTES ON SOME OF THE MANUFACTURING PROCESSES EMPLOYED IN THE WORKS OF THE PARIS GAS COMPANY.

[Translated from the *Journal de l'Eclairage au Gaz.*]

Twenty years ago the gas lighting arrangements in Paris were in the hands of several small companies, who divided between them the whole of the gas business then in existence in the French capital. In the year 1855, however, these companies amalgamated, and, incorporated in one body, became what is now known as the Paris Gas Company. This company has the exclusive privilege of supplying gas to the city of Paris and its environs for a period of fifty years from the date of the amalgamation. At the time this undertaking was entered upon the supply of gas furnished annually by the company did not amount to more than 30,000,000 cubic mètres (1,059,000,000 cubic feet); now, according to the company's last report, it is upwards of 150,000,000 cubic mètres (over 5,000,000,000 cubic feet) annually. The manufacture of gas is conducted at ten separate works, situated respectively at La Villette, Les Ternes, Passy, Vaugirard, Ivry, Belleville, St. Mandé, St. Denis, Boulogne, and Maisons Alfort, and from these the various parts of the city and suburbs are supplied.

The company's chief product of manufacture is illuminating gas, and this they obtain either by means of ordinary gas-retorts, or by the patent coke ovens of MM. Pauwels and Dubochet. The coke resulting from the distillation of coal in the ordinary retorts is found, from its light nature, to be well adapted for domestic use; that which comes from the ovens, on the contrary, being hard and very dense, is generally sold for railway purposes, or for use in metallurgical industries.

The profitable disposal of the other residual products is a matter on which the company have bestowed considerable attention. This section of their business is conducted in works specially constructed for the purpose, in which are to be found all the necessary appliances for turning these products to profitable account in either domestic or industrial operations. Thus the treatment of the tar and ammoniacal liquor is a branch of industry which has been recently added to the company's business, and this is carried on at three of their principal stations, as well as in works specially arranged.

The retorts and fire-clay goods used by the company are manufactured at their station at La Villette, and, by undertaking themselves the manufacture of these articles, they are in a position to produce them in sufficiently large numbers to enable them, if required, to supply them to any foreign gas company requiring them. It is also at La Villette that the boiler and other sheet-iron work required by the company is produced; such, for instance, as the plates for the roofs of gasholders, tar and water tanks, condensers, &c.

Another portion of the works is devoted to the construction of the various kinds of gas-engines which for several years have been so usefully and so variously employed in Parisian industry, and which have, so to speak, popularized the use of gas as a motive power—in some cases advantageously supplying the place of steam, and always found to be an economical substitute for manual labour.

In a city like Paris, where the public and private consumption is necessarily very large, the work of laying the street-mains is one requiring the strictest supervision. In certain streets the traffic is exceptionally great; besides this, the presence beneath the soil of water-pipes, drains, and other obstructions adds to the difficulty experienced in carrying on main-laying operations. This highly important branch of gas industry is in the hands of the Paris Gas Company, who, to meet the demands made upon them by a constantly increasing service, have had to devise new modes of operation in this part of their business. The attention they have given to these matters has resulted in the introduction of a better system of laying and fixing the mains, the adoption in certain cases of mains of unusually large diameters, the employment of specially designed taps and cocks, and generally in the use of such improved apparatus as would enable them to perform satisfactorily work requiring so much care and attention. The difficulties attending this work have only been overcome by the help of these improved working arrangements, the details of which were made the subject of much study and careful experiment before they could be turned to practical account.

Treatment of the Tarry Matters.

The treatment of the tarry matters resulting from the distillation of coal is conducted in the works at La Villette. These works possess engines of a total power of nearly 80 horses, and employ ordinarily more than 120 men. They have been completely modified during the past five years, and now cover a space of 5½ hectares (about 13½ acres). The amount of tar distilled annually exceeds 25,000 tons. The following are the principal productions from these works:—

The *light oils*, which, in specially arranged works, are submitted to various processes with the view of obtaining the commercial products known as *benzine*, used for scouring purposes, the manufacturer of vulcanized india-rubber, &c.; *carbonic acid*, employed in the preparation of picric acid, and useful also as a disinfectant; and *benzole*, the raw material from which aniline is manufactured.

In addition to the above, the manufacture of *anthracene*, an article employed in the production of artificial alizarine, has lately been incorporated with the other operations at these works.

Heavy oil, used for the preservation of wood, for coarse painting, and for the manufacture of lamp-black; it may also be advantageously employed for the heating of ovens and steam-boilers.

Pitch, used for the agglomeration of small coal, the preparation of artificial bitumen, &c.

Lastly, with the object of utilizing one of the residuals which in itself is almost valueless, but which is produced in abundance in gas-works—viz., the breeze—special works have been started for treating it with pitch, and, by a combination of the two substances, producing a combustible material adapted for use in steam-boilers, or, mixed with a certain proportion of coke, for the heating of gas-ovens.

To lessen the possibility of nuisance being created by carrying on, in the interior of Paris, manufacturing operations which have not hitherto been conducted without causing some slight inconvenience to the neighbourhood in which the works are situated, the Paris Gas Company have introduced some important improvements in this portion of their business, of which the following are some of the principal.

In order to reduce as much as possible the risk of contaminating the well water in the neighbourhood of their works by the infiltration of the oily products through the soil, the tarry matters, and the oils resulting therefrom, are stored in large tanks supported on blocks of masonry. These receptacles are so placed as to admit of easy inspection, and thus a considerable expense for manual labour is saved when they have to be emptied. The oils are run direct from the stills into portable iron tanks, and then conveyed, under atmospheric pressure, to large reservoirs, in which they are stored. By means of this simple arrangement a great deal of labour is saved, loss avoided, and the risk of fire considerably reduced.

Another very simple contrivance enables the company to run their pitch into the depositing-tanks without the production of the disagreeable odours usually prevalent when this operation is going on. The arrangement is thoroughly practical, and by it more than 180 tons of pitch are conveyed daily a distance of over 100 yards without the least trace of smell.

In the prolonged distillation of tar for the production of anthracene, a novel form of apparatus has been introduced in connexion with the coppers; by its aid the liquor is kept continually agitated during the process of distillation, and the result is a reduction to a very great extent of the deposits at the bottoms of the vessels.

Treatment of the Ammoniacal Liquors.

The ammoniacal liquors resulting from the distillation of coal are treated in three special works by means of apparatus devised by M. Mallet. The quantity of these products obtained amounts annually to close upon 3000 tons. They consist of—

Sulphate of ammonia, employed in the manufacture of alum and for agricultural purposes. The employment of this article as manure has developed to a remarkable extent during the past five or six years. The azote assimilable by plants is found in sulphate of ammonia in a fixed state, and, consequently, is not liable to volatilize and so become lost, as is the case with Peruvian guano and every other fermentable matter; its effects are not so rapid as those of guano, but are far more durable.

Volatile alkali, or solution of caustic ammonia, used for dyeing and scouring, for the apparatus employed in M. Carré's freezing system, &c.

The introduction of special apparatus so combined as to allow the fumes given off during the treatment of the ammoniacal liquor to be sent into flues communicating with large chimneys, does away with the nuisance so long dreaded by the residents in the neighbourhood of the works, and, while adding to the salubrity of the workshops, tends to improve the health of the work-people employed therein.

Various other new apparatus, such as manometers and safety-valves adapted to distilling vessels, have been devised with the view of lessening the liability to accidents, which have not unfrequently been caused in certain works through the obstruction of the pipes with ammoniacal salts.

Manufacture of Fire-clay Goods.

It is also at La Villette, and in close proximity to the Canal St. Denis, the Northern and Eastern Railways, and the line of the Ceinture, that the manufacture of fire-clay goods is carried on.

The process of grinding and mixing the earths and cements, the kneading of the paste, the transport of the goods to the different parts of the works, are carried on mechanically by the aid of a 40-horse power engine. The shaping of the various articles, which requires great care, is done solely by hand.

The drying-rooms are heated, at little or no expense, either by the waste heat from the baking-ovens or by steam from the engine, circulating in pipes through the whole extent of the workshops.

The baking process is carried on in ovens furnished with two or four furnaces, heated by coke from the works. The number of clay retorts manufactured annually reaches nearly three million. In addition to these, more than 20,000 articles of other kinds, in extra-refractory composition, for the setting of ovens (blocks, key-stones, &c.) are produced, and one million fire-bricks.

Let us point out, further, that the company have discovered a method of utilizing the scoria from the furnaces of the gas-ovens. It is made up into a composition consisting of more than half by weight of its own material, and thus a very hard substance is obtained, which would be useful in the paving of workshops, stables, and similar places.

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* The best method for estimating the total amount of sulphur.

AMERICAN WATER GAS RESEARCHES.

A Report by Professors Wurtz and Silliman.

[From the *American Gaslight Journal.*]

(*Continued from page* 545.)

II.

Experimental Results obtained with Various Coals by the Gwynne-Harris Process.

The daily record embodied in the tables at the close of this report gives the data for a considerable variety of calculations. But we propose to give in this chapter specific statements of the results obtained by us at Fair Haven, in operating upon a variety of coals and materials by the hydrocarbon process, and to bring these results into contact with each other, as well as with those obtained from the treatment of the same materials by the common process.

Westmoreland Coal.

This coal is from Western Pennsylvania, in the Pittsburgh basin, and is in great favour among gas engineers in the United States. It has been the basis of our hydrocarbon experiments at Fair Haven, for reasons already stated.

In the dry way, by ordinary process, this coal yields on an average sample as follows:—

Charge, 224 lbs., carbonized 3 h. 20 m., produced per ton	9,500 cubic feet.
Illuminating power, standard Argand	16·62 candles.
Weight of coke, per ton	1,544 lbs.
Bushels of coke per ton	40
Maximum yield of gas per ton	10,642 cubic feet.
One bushel of lime purified*	6,420 „

Analysis of the Coal.

Volatile matter	36 per cent.
Fixed carbon	58 „
Ash	6 „
	100 per cent.

Value of the gas from one ton estimated in pounds of spermaceti = 541·26 lbs.

The above results were obtained in the experimental works of the Manhattan Gaslight Company, New York, where the daily average yield of gas from this coal and its equivalent the "Penn" is about 10,000 cubic feet of 15-candle gas.

At the New Haven Gaslight Company's works, where this coal is used alone for the four summer months, and with the addition of 5 per cent. to 6 per cent. of Albertite during the remaining eight months, the average yield of gas for the whole year 1868 was. . . . . 4·11 cub. ft. per lb.

Or, to the ton of 2240 lbs.	9,206 „
Of an average candle power of	18 candles.
Giving for the value of one ton	568 lbs. of sperm.

An examination of the results recorded in our Tables C. and D will show the product of the Westmoreland coal with 10 per cent. of Albertite added, when treated by the hydrocarbon process, from Jan. 27 to Feb. 12, was as follows:†

Average yield per lb.	6·34 cub. ft.
Average yield per ton	1,4201·6 „
Illuminating power	20·72 candles.
Equal in pounds of sperm for 1 ton	1,008·95 lbs.

From the 29th to 31st of March, returns of Table D, the Westmoreland coal *alone* was treated by the hydrocarbon process, at Fair Haven, giving the following results:—

Average yield per lb. of coal carbonized	6·27 cub. ft.
Average yield per ton of coal carbonized	14·057 „
Illuminating power of 5 cubic feet of gas burned in standard Argand	16·55 candles.
The gas from 1 ton of the coal by the hydrocarbon process is equal in lbs. of sperm to	797·634 lbs.
From the ordinary process we have above	541·257 „
Giving gain for the hydrocarbon process	256·377 lbs.
The ratio of gain in total economical effect is therefore as 100: 147·79, or in per centage	47·79 per cent.

The illuminating power in these two cases was substantially identical.

No enriching coal whatever, it will be remembered, was used in this trial. The result is certainly sufficiently remarkable as coming from a caking coal. It is worth while to bring the gas produced in the two cases, of equal candle power, into direct contrast, as follows:—

Gas from 1 ton of Westmoreland by the hydrocarbon process	14,057 cub. ft.
From 1 ton, common process	9,500 „
Gain in gas by hydrocarbon process	4,557
Corresponding to a gain by this mode of statement of	47·97 per cent.

This is what gas makers will consider as the *practical* difference, while that exhibited by the value in lbs. of sperm is the true *economical* difference, viewed from the side of the consumer.

EXPERIMENTS WITH RESIN AS THE ENRICHING MATERIAL.

(*a.*) From December 1st to 28th inclusive (see Table A), the gas made by the hydrocarbon process at Fair Haven was from—

Westmoreland coal	95 per cent.
Resin	5 „

The amount of gas registered at the meter was 353,600 cubic feet, or 6·04 cubic feet per lb.; and with the proper corrections for contaminating air, this amount was reduced to 5·56 cubic feet. The account stands thus:—

58,800 lbs. coal and resin gave gas	363,600 cub. ft.
Equal per lb. to	6·01 „
Equal per lb. corrected for air	5·33 „
Observed candle power, average	15·67 candles.
Corrected candle power	19·67 „
One ton gave gas, corrected for air	12,454·4 cub. ft.
One ton of Westmoreland coal and 5 per cent. Albertite, at New Haven works, common process, gives	9,206·0 „
Gain in volume by hydrocarbon process	3,248·4 cub. ft.
Gain in per centage of gas	34·55 per cent.

Illuminating power substantially alike.‡

Value of 1 ton of this mixture by the hydrocarbon process in terms of spermaceti	840·20 lbs.
The same by ordinary process	568 „
Gain in total economic effect	272·20 lbs.
Per centage gained by hydrocarbon processes in total economical effect	47·92

(*b.*) From February 13 to 28 the gas was made from—

Westmoreland coal	90 per cent.
Resin	10 „

24,160 lbs. of this mixture gave by the hydrocarbon process—

Gas	159,600 cub. ft.
When corrected for air equal per lb.	6·14 „
2240 lbs. (1 ton) give therefore	13,758·7 „
Illuminating power (corrected).	21·08 candles.
Illuminating power of 5 per cent. mixture (*a.*)	19·67 „
Gain equal 7½ per cent. over the 5 per cent. mixture, or equal	1·49 candles.
Total economical value of 1 ton of this mixture in lbs. of sperm	997·8 lbs.
Economical value of 5 per cent. mixture (*a.*) equal	840·20 „
Gain by addition of 5 per cent. more resin	157·60 lbs.
Gain by addition in per centage.	18·75 per cent.

This trial shows that the Westmoreland coal, with 10 per cent. resin added, gives almost exactly the same total economical effect by the hydrocarbon process as was obtained from the same coal with 10 per cent. of Albertite, being a difference of only 11 lbs. of sperm in favour of the latter mixture.

As there are many situations in this country where resin is the cheapest and most conveniently obtained of all enriching materials, it is satisfactory to know that its value, when used in connexion with common caking coals, is such as to equal the Albertite as an enriching material, while in the situations alluded to its cost is much less.

It will be remembered that in the early experiments on White's process in England, it was especially adapted to making resin gas. The results here given must not be confounded with those then obtained. By our plan of proceeding, the quantity of resin employed is restricted to 10 per cent., and this gives excellent results in every way. The coke is uninjured; no accumulations occur in the stand-pipes or hydraulic main; and the gas is completely purified, without using the washer, by the dry lime purifiers only.

BLOCKHOUSE COAL, COW BAY, NOVA SCOTIA.

This coal, owing to its nearness to the northern ports of the United States, its fair illuminating power and good gas-producing qualities, is well esteemed by some of our gas engineers. Good cargo samples of this coal make, by dry process, from 9500 to 10,000 cubic feet per ton, of a candle power from 16½ to 17½ candles. But we have found it quite variable in quality, producing gas sometimes of only 15-candle power. It is quite sulphurous, one bushel of lime purifying only from 2000 to 2500 cubic feet of the gas.

A small sample of six tons, obtained for the purpose of testing the coal by the Gwynne-Harris hydrocarbon process, reached us in very bad condition, wet and much comminuted, and the following results cannot be considered, therefore, as a fair criterion of what may be expected of it when a good sample is tested.

By the hydrocarbon process, the Blockhouse gave the following results when treated alone:—

4200 lbs. of coal made	23,600 cub. ft. of gas.
Yield per lb.	5·62 „
Yield per ton	12·589 „
Illuminating power	14·08 candles.
Value of 1 ton in lbs. of sperm.	607·72
In another trial, with 10 per cent., of Albertite added, 6950 lbs. of coal made	39,300 feet of gas.
Yield per lb.	5·65 cubic feet.
Yield per ton	12·656 „
Illuminating power	15·75 candles.
Value of 1 ton in lbs. of sperm.	683·42

Giving a gain in total economic effect of 33·22 per cent. by the hydrocarbon process.

ALBERT COAL—"ALBERTITE."

This very remarkable material from New Brunswick is too well known to all gas engineers in the Eastern United States to require any description here. Its almost complete freedom from sulphur and from ash, and its very large yield of rich gas, make it the most highly esteemed of all the enriching materials at present available for gas-making in the eastern portion of the United States. Unlike most cannels, its use does not sensibly impair the value of the coke produced; while it imparts, even in quantities as small as 5 per cent., a very satisfactory quality to the gas from common caking coals. It is not well suited to carbonization alone, owing to its highly inflammable nature, in which it resembles asphaltum. But we have obtained some results with it by the hydrocarbon process which are hereafter given.

The following results on its gas-producing powers by the common process were obtained at their experimental works by the Manhattan Gaslight Company in New York:—

Weight of charge per retort, 224 lbs. Time of carbonizing, 3 hours 10 min.

Yield of gas per ton of 2240 lbs., 14,784 feet (equal 6·6 feet per lb.). Illuminating power of 3 cubic feet burnt in a Scotch tip fishtail, 29·74 candles, equal per 5 cubic feet to 49·55 candles.

Yield of coke per ton	16·8 bushels.
Weight of coke per ton	806 lbs.

Gas perfectly purified by lime.

The coke burns well and rapidly, without clinker.

Analysis of Coal.

Volatile matter	57·70
Fixed carbon	41·90
Ash	0·40

We deduct from this the value of 1 ton in pounds of sperm equal 2511·57 lbs.

AN EXPERIMENT ON ALBERTITE WITH THE HYDROCARBON PROCESS.

This experiment was made with a view especially to compare the effect of the delivery of the gases from the anthracite retort into the centre of the bituminous coal retort, with that of a delivery into the mouthpiece; which latter was our more usual mode of commingling the two products.

First trial—the water gas being carried by a tube of iron 3 feet into the retort containing the Albertite.

Fifty pounds of Albertite charged in one retort, and the water gas turned on, ran off all the product in 1 hour 40 min.

Gas produced, 640 cubic feet, equal to 12·8 feet per lb.

Illuminating power, in standard Argand burner, burning 3·2 feet per hour, computed for 5 feet, equal to 24·79 candles.

Volume of gas per ton of 2240 lbs.—equal to 28,672 feet.

Second trial—the water gas being delivered into the mouth of the other bituminous coal retort, containing a charge of—

Fifty pounds of Albertite; carbonized in two hours, producing 460 cubic feet of gas, or 20,608 cubic feet per ton.

Illuminating power not determined.

By a comparison of these results, it appears that there is an important advantage in delivering the water gas in the rear of the bituminous coal charge. But too much importance must not be attached to this single result, which further experiments of the same character upon the Boghead cannel do not appear to confirm.

The Albert coal, by our experience, does not increase its yield by the hydrocarbon process, while it adds very greatly to the illuminating power of the common caking coals when these are treated by this process. The above results are far too few in number to justify an absolute opinion. But, so far as they go, they afford the following comparison:—

Increase in volume of gas from Albertite alone by the hydrocarbon process, 28,627 — 14,784 = 13·888 cubic feet, or 93·9 per cent.

Illuminating power of Albertite.	49·56 candles.
Illuminating power by hydrocarbon process	24·79 „
Loss	24·77 candles.
Total economical effect of 1 ton of Albertite, stated in pounds of sperm, equal by ordinary process	2511·57 lbs.
By hydrocarbon process	2436·95 „
Loss by hydrocarbon process	74·62 lbs.

Or, by ratio, 2·9 per cent.

This result is not unexpected. The Albertite is a very peculiar and exceptional material. Its products of destructive distillation belong to the naphtha, beta-naphtha, and ethylene series,* and it resembles the asphaltes in its characters

* It is worthy of remark that in carbonizing over 6000 tons of Westmoreland coal at New Haven in 1869, the lime required for the purification was almost exactly 1 bushel to 6000 cubic feet.

† These results are reduced to the true yield by subtracting the air found by analysis as an impurity, and correcting the candle power accordingly.

‡ With 5 per cent. Albertite, the New Haven gas ranges from 18 to 20 candles, averaging 19. With Westmoreland alone it is about two candles less.

* C. M. Warren, as quoted in Dana's "Mineralogy," fifth edition, p. 753.

more than the coals. Its decomposition is so rapid as to render it difficult to manipulate in a coal gas retort by itself alone. And it is highly probable that when thus employed, its illuminating hydrocarbons are broken up into those of lower equivalents and into marsh gas. Its true use to add brilliancy to the common caking coals when used *in small quantities*, and, for that purpose, it is an enriching material of the greatest value.

Grahamite.—In connexion with the Albertite, it is proper to mention another hydrocarbon of a somewhat similar character, which was first brought to the notice of the scientific and practical world by Professor Henry Wurtz. It occurs like the Albertite, filling a fissure in the carboniferous rocks near Cairo, in Ritchie County, West Virginia.

As this material exists in very considerable quantity, and is available to all the cities of the central parts of the United States, it is worth while to put on record here its gas-producing value, as determined at the Manhattan Company's experimental works:

100 lbs. carbonized in 1 hour 20 min.

Yield of gas per lb., 6·7 cubic feet; and per ton	15,000 cub. ft.
Illuminating power of 5 cubic feet, burned in a bat's-wing burner	28·7 candles.
Yield of coke per ton	44 bushels.
" "	1,056 lbs.

Thirty-three per cent of the coke is very fine. The coarse portion makes a very clean, hot fire, leaving but little hard clinker or ashes.

There was not enough of the material at hand to determine the sulphur, by the lime required to purify it. It is, however, quite sulphurous.

Analysis of the Grahamite.

Volatile matter	53·5 per cent.
Fixed carbon	44·5 "
Ash	2·0 "
Total	100·0 per cent.

The total economical value of one ton of the Grahamite, estimated in terms of spermaceti, 1476 lbs.

We had no opportunity to test the Ritchie County mineral by the hydrocarbon process; but by a comparison of the total economical effects of the two, the advantages is largely with the Albertite.

EXPERIMENTS WITH "PEYTONA" (WEST VIRGINIA) CANNEL COAL.

One of the most remarkable of all American coals, of the cannel variety, is that from Coal River, in Boone County, West Virginia, owned by the Peytona Cannel Coal Company, and known as the "Peytona Cannel." As this coal exists in great abundance over a considerable area, and is quite available at present at moderate prices on all the systems of inland navigation and transportation of the Central and Western States of the Union, and can even now be laid in New York in competition with foreign cannels, we have given some attention to it in connexion with the hydrocarbon process.

A careful examination of its qualities by the ordinary method of dry distillation was made at the excellent experimental works of the Manhattan Gaslight Company, in New York, with the following results:—

Six charges of 1-10th of a ton each (equal 224 lbs.), carbonized for three and a half hours, gave respectively as follows, viz:—

1.—1124 cubic feet, or per ton	11,240 cub. ft.
2.—1000 " " "	10,000 "
3.—1215 " " "	12,150 "
4.—1210 " " "	12,100 "
5.—1234 " " "	12,340 "
6.—1226 " " "	12,260 "
Average 1168 " " "	11,682 "
Maximum yield on 112 lbs. equal to 666 cubic feet, or in cubic feet per ton.	13,320 "

Illuminating power by 5-feet fishtail burner, under 1-inch pressure, burning 5 feet of gas per hour, 41·16 candles.

By mixing 10 per cent. Peytona gas with 90 per cent. of street gas of 14·99 candle power, burned in standard Argand, 42·79 candles, from the maximum yield of 13,200 feet, illuminating power was 32·66 candles. This is equivalent for a 10,000 feet yield.

Refrigerated to — 6° Fahr., the candle power fell from 41·16 to 35·99 candles, burning from a fishtail burner; the loss of 5·17 candles, being equal to 12½ per cent. of its illuminating power. Another sample of larger volume, having a candle power = 29·24, lost but 1·04 candles, or 6·6 per cent.

4510 cubic feet of the gas were purified by one bushel of lime.

13,80 lbs. of coke and breeze were made per ton, or 32 bushels of coke, and 3 bushels of breeze per ton.

The Analysis of Coal.

Volatile matter	46 per cent.
Fixed carbon.	41 "
Ash	13 "
Total	100 per cent.

The coke is poor, making a dull fire and a large bulk of light ash.

The fair statement of the illuminating power of this gas per 10,000 cubic feet from 2240 lbs. is 24 candles; equal to sperm per ton, 1440 lbs.

The mean of six trials with 100 lb. charges of Peytona coal by the hydrocarbon process gave nearly 10 cubic feet of gas per pound, of an average candle power of 23·25 candles.

Gas from one ton	22,400 cubic feet.
Candle power of one foot	4·65 candles.
Sperm equal to one ton of coal	1785·6 lbs.

In these trials the water gas was employed in the mouthpiece as usual, and at the rear end of the retort alternately. There was a clear advantage in candle power in the gas when the former course was employed, and a little gain in the yield of gas in the latter. But further trials are wanted in this direction to give data which can be safely made a basis of practical operations. As at present advised, our results favour on the whole the more simple form of introducing the water gas directly into the mouth of the bituminous coal retorts.

We are of opinion that much better results will be obtained from coal in the large way, by the hydrocarbon process, than those here quoted. These show, nevertheless, a total economical gain of 24 per cent. over the ordinary process, as estimated in the total illuminating power of the gas from one ton, converted into its equivalent of sperm candles.

BOGHEAD CANNEL.

This remarkable mineral is too well known to all gas engineers to need any description. The illuminating power of the samples which reach this country is much less than the values assigned to it in England; but the following results are comparable among themselves, and give our own experience.

We quote from the very ample experimental data of the Manhattan Gaslight Company of New York the following working result on Boghead, which presents a fair mean of several results of a like kind:—

200 lb. charges, carbonized in three hours; yield, per ton, 13,619 cubic feet (equal 6·07 ft. per lb.)

Illuminating power of three feet of gas, 15·88 candles—equal for 5-feet standard to 26·45 candles.

Yield of coke, per ton	35 bushels.
Weight of coke "	1378 lbs.
Number of cubic feet of gas purified to one bushel of lime	3400

The coke is worthless as fuel.

Analysis of the Coal.

Volatile matter	51·60 per cent.
Fixed carbon	15·70 "
Ash	32·70 "
Total	100·00 per cent.

We deduce from the above data the value of one ton in pounds of sperm 1235 lbs.

EXPERIMENTS ON BOGHEAD CANNEL BY THE GWYNNE-HARRIS PROCESS.

Feb. 10, 1869.

Charges of 100 lbs. weight.

Gas from the anthracite retort turned on to the Boghead charge during two hours, alternately for each retort. The charges were carbonized in three hours. The illuminating power was determined by burning 3 feet of the gas in an Argand standard burner, drawn from the main on its way to the holder, at the close of one hour from the commencement of each charge.

Weight of coal carbonized	200 lbs.
Volume of gas registered	2100 feet.
Illuminating power, end of 1 hour, mean of 15 corrected observations, computed for a consumption of 5 feet per hour (standard Argand)	28·85 candles.
Value of 1 cubic foot of the gas	5·77 "
Gas per 2240 lbs. (equal over 10 feet per lb.)	23,200 cub. ft.
Equal lbs. of sperm per ton of coal	2,326·46 lbs.

The gas was free from carbonic acid.

In these trials the water gas was delivered into the mouthpieces of the bituminous coal retorts.

In another trial—

100 lbs. Boghead cannel carbonized 2 hours gave a yield of	1500 cub. ft.
Candle power in a 5-feet Argand	22·22
Yield per ton of 2240 lbs.	33,600 cub. ft.
Pounds of sperm equal 1 ton of coal	2,559·74 lbs.

Feb. 25, 1869.

In these trials the water gas was carried through a flue constructed for the purpose over the top of the bituminous coal retorts, giving to them, in effect, the character of "diaphragm retorts," such as were originally suggested in White's patent.

First charge—100 lbs., carbonized in 2 hours.

Gas produced	1020 cub. ft.
Illuminating power, taken when 500 feet had passed the meter	32·45 candles.

Second charge—100 lbs., carbonized in two hours.

Gas produced	1000 cub. ft.
Illuminating power, taken when 700 feet had passed the meter	28·78 candles.

Third charge—100 lbs., same time—

Gas produced	1100 cub. ft.
Illuminating power, after 700 feet had passed the meter	28·85 candles.

Fourth charge—100 lbs., same time—

Gas produced	1000 cub. ft.
Illuminating power	29·15 candles.

Recapitulation.

400 lbs yielded	4220 cub. ft.
Average illuminating power	29·8 candles.
Gas of this power to 1 ton of 2240 lbs.	23,072 feet.
Pounds of sperm equal to 1 ton of coal	2357·3 lbs.

No carbonic acid was detected in this gas.

Feb. 26.

In comparison with the foregoing results are the following, obtained by carrying the water gas into the mouthpieces of the bituminous coal retorts:—

First charge—100 lbs., carbonized in 2 hours.

Gas produced at close of second hour	1050 cub. ft.
Illuminating power at the end of first hour	30·67 candles.

Second charge—100 lbs., carbonized in 2 hours 1100 cub. ft.

Illuminating power after 700 feet had been registered, the gas being, as in all the former cases, drawn directly from the main on its way to the holder	22·87 candles.
Average yield per 100 lbs. 1075 cubic feet	24,086 per ton.
Average illuminating power	26·77 candles.
Pounds of sperm equal 1 ton of coal	2210·13 lbs.

[It is probable the candle power in the two trials last named was in reality identical, but the second test was taken a little too late in the charge to obtain a fair average.]

(*To be continued.*)

ON THE ESTIMATION OF THE SANITARY CONDITION OF COMMUNITIES, AND THE COMPARATIVE SALUBRITY OF TOWNS.

SOCIETY OF MEDICAL OFFICERS OF HEALTH.

On Saturday Evening, Oct. 17, the First Meeting of the present Session of the Society of Medical Officers of Health was held in the Scottish Corporation Hall, Crane Court, Fleet Street, when Dr. LETHEBY, the president, read a paper, "On the Mode of Estimating the Sanitary Condition of Communities, and the Comparative Salubrity of Towns."

Dr. LETHEBY commenced by observing that this important problem was not nearly so simple nor so easy of solution as was generally supposed, and that the common and vulgar method of estimating it by the death-rate, as usually calculated, was entirely fallacious. In proof of this he alluded to the disturbing effects of migration, the birth-rate, the proportion of the two sexes, and other circumstances, in vitiating the results; and he quoted a number of authorities in proof of it. As regards migration, he said that when there was a notable migration of young adult lives from country to town, as was generally the case, the death-rate of the rural district in which the young lives had been produced was unduly augmented, while that of the town, which acquired such lives without the vital cost of rearing them, was proportionately reduced. That was the condition of things in every large town in the kingdom, and he took London as an example.

Seven-and-twenty years ago the population of London, as determined by the census of 1851, was 2,362,236. In 1861 it amounted to 2,803,989 persons; and at the last census, in 1871, it was 3,254,260. So that in 20 years the total increase was 892,024 persons, or nearly 38 per cent. The natural increase in that time, as estimated by the excess of births over deaths, was only 595,111, or only about 25 per cent. The difference, therefore—namely, 296,923, or nearly 13 per cent.—was referable to the additions made to the population by the entrance into it of fresh lives; and that was altogether independent of the large number of such lives which took the place of those who, from sickness or other cause, left the metropolis to live and die elsewhere. All those were young healthy lives, at perhaps an average age of 20; and the cost of producing them must have been considerable.

In London the death-rate of infants was so large that not more, and probably much less, than 60 out of every 100 born lived to be 20 years old. At this rate the 296,923 young adults who were added to the population of London during the last 20 years would, if they had been produced here, have cost 494,872 births and 197,949 deaths, not one of which had appeared upon the registers of the metropolis.

It was hardly possible to compute the exact number of young persons who, in addition to the preceding, had come to London and taken the place of the sick and infirm who had left it; but an examination of the census would show that nearly half the population of London were aliens, and had migrated to it from the provinces. Probably the net immigration during the 10 years from 1851 to 1861 amounted to 31,820 persons per annum, or rather more than double the annual number of young recruits (13,356), which, as before said, went to the increase of the population. Assuming that they were at an average age of 20, they would, if they had been produced in London, have cost annually 53,030 births and 21,213 deaths. Some of those, or their equivalents, might have appeared upon the registers; but it was easy to perceive how the vigour, as well as the numerical strength of London, was maintained without the cost of infant life, and that which was a gain to London was necessarily a loss to other places. How much the statistics of mortality had been disturbed by such migrations could not be precisely estimated, but no doubt they had been vitiated to such an extent as to render them useless as exponents of facts.

Dr. Letheby proceeded to show, from another set of facts—viz., the proportions of males and females at different ages in the population of London—that there was a large influx of young adult lives; for, although the proportion of children in the population of London was relatively small, especially in the heart of the City, where it amounted to only 263 per 1000 of the population, as against 356 for all England, yet the number of young persons at from 15 to 35 years of age was strikingly large. In the City proper it amounted to 415 per 1000 of the inhabitants, and in the whole metropolis it was 360 per 1000; whereas in England and Wales it was but 335 per 1000. At 55 and upwards the number for the metropolis was only 89 per 1000, as against 105 for all England. The proportion of females, also, in the population of London was very large. In the heart of the City the number of women at from 15 to 55 years of age amounted to 337 per 1000 of the inhabitants, and in the rest of the metropolis it was 315 per 1000, although for England and Wales it was only 280 per 1000. All this was attributable to the migratory character of the population of London, for at the census of 1861 there were more than half a million persons who could hardly be said to have a fixed home in London. There were, for example, 153,104 female domestics, besides about 96,400 milliners, dressmakers, shirtmakers, sempstresses, &c., of less than 35 years of age; and those, with rather more than 257,000 shopmen, porters, messengers, clerks, servants, labourers, mechanics, &c., make up a total of 506,676 persons under 35 years of age, who would doubtless leave London when, from sickness or other cause, their labour became unremunerative. This was clearly shown in the tables of mortality at different ages. Up to the age of 10, and after the age of 25 in the case of males and 35 in that of females, the death-rate in London was much greater than it was in all England; but at the intervening ages, from 10 to 25 and 10 to 35 respectively, the death-rate in London was much below the average—showing that persons of those ages left London when sickness oppressed them; and that was further proved by the fact that as the mortality fell in London it rose in the neighbouring counties, where the sick and infirm resorted. The disease which most strikingly exemplified this was phthisis—a disease which not only attacked persons in the prime of life, but also gave them ample opportunity for removal to the country.

From the above enumerated facts, Dr. Letheby concluded that the gain to London by such migrations was threefold. In the first place, the population was constantly receiving a large number of young adult lives without the vital cost of producing them; in the second place, it gained by the substitution of such lives for the weak and ailing; and, in the third place, it gained by the fusion of such lives, of high value, with the general mass of the population of comparatively low value; for, at the age of 20, the death-rate was only about 7 per 1000, whereas that of the general population was more than 24 per 1000.

A like condition of things prevailed in all the cities and large towns of the kingdom; and it so seriously disturbed the death-rate, as usually calculated, as to make it no longer expressive of facts. In those cases where sick persons resorted to public hospitals, or to the favourite sea-side places of England, the disturbance was still greater. There was a good example of that in the western division of the City of London, where St. Bartholomew's Hospital is situated; for, according to the returns of the Registrar-General, the average death-rate of that district was from 45 to 50 per 1000, whereas the true death-rate was from 27 to 29 per 1000. In like manner the death-rates of Whitechapel, of Islington, and of other districts of London were disturbed by the presence of large hospitals.

Another circumstance which destroyed the sanitary value of a death-rate was the birth-rate. This was illustrated by the fact that wherever the birth-rate was high the death-rate was high also; and that was observed not only among the nations of Europe, but also among the registration counties and districts of England. France, with a birth-rate of only 26·26 per 1000 of the population, had a death-rate of only 23·63 per 1000; but Austria, with a birth-rate of 39·86 per 1000, had a death-rate of 30·34. Spain, Italy, and Prussia exhibited the same general relation; and in England the registration divisions, the counties, and the towns showed a similar condition of things. Taking, for example, the 10 registration divisions of England and Wales, it would be noticed that the birth-rates and the death-rates were closely comparable. Beginning with the south-western counties, where the birth-rate was only 32 per 1000 of the population and the death-rate less than 20 per 1000, it would be noticed that as we passed on in the order of increase the birth-rates and death-rates advanced together; so that when they came to the last of the series—the north-western counties, where the birth-rate was nearly 39 per 1000—the death-rate was 26·3.

The same thing was observable in the individual counties of England. Twenty of them had an average birth-rate of from 30 to 33 per 1000, and a death-rate from 18 to 21 per 1000; while the rest of them (21 in number) had a birth-rate which ranged from 33 to 42 per 1000, and a death-rate from 19 to 27. In the former group the mean birth-rate was 31·8 per 1000, and the death-rate 19·6; and in the latter they were 35·7 and 22 respectively. As a general fact, it might be said that where the birth-rate was from 30 to 31 per 1000, the death-rate was about 19; where it was from 31 to 33, the death-rate was nearly 20; where it was from 33 to 35, the death-rate was nearly 21; where it was from 35 to 37, the death-rate was nearly 22; and where the birth-rate exceeded 37 per 1000, the death-rate averaged 24·4. As individual examples, the Ridings of Yorkshire might be taken as good illustrations. In the North Riding the birth-rate was 33·9 per 1000, and the death-rate 20·5; in the East Riding the numbers were 34·5 and 22·7; and in the West Riding they were 38·1 and 24·9.

It was not possible, without considerable labour, to compare the birth-rates and death-rates of the town and rural districts of England; but Dr. Stark had done this for Scotland, and the results were remarkably instructive; for in the principal towns of Scotland, where the population exceeded 25,000, the average birth-rate was 38·73 per 1000, and the death-rate 28·25. In the large towns, with a population of from 10,000 to 20,000 persons, the birth-rate is 38·07 and the death-rate 24·57; in the smaller towns the numbers are 36·44 and 21·24; and in the rural districts they are 31·49 and 16·95. So, also, if we take the large towns of England and Scotland, and group them according as the birth-rate is over 38 per 1000 or below it, it will be found that in the former case the average birth-rate is 39·6 per 1000, and the death-rate 29·5; whereas in the latter the numbers are only 34·4 and 25·7. These facts are indisputable, and according to Dr. Letheby they afford conclusive evidence of the reciprocity of these numbers. They show, indeed, that they are in some way mutually dependent, or perhaps related, as cause and effect.

Dr. Stark believes that a high birth-rate is an effort of nature to compensate for the excessive waste of life in large towns; and the Registrar-General appears to hold to a like opinion; for he says that "wherever, from the combined effects of intemperance, dirt, and bad ventilation and drainage, the mortality is greatest, there also the ratio of births to the population is highest." But Dr. Letheby reverses the argument, and says, with Mr. Andrew Watt, of Montreal, "that wheresoever the ratio of births to the population is highest, there also the mortality is greatest; and, the conditions being equal, will be in proportion to the birth-rate." Dr. Letheby has already expressed this opinion in one of his annual reports of the sanitary condition of the City of London; and the Registrar-General has replied to it in a memorandum of the "Significance of Rates of Mortality;" but Dr. Letheby complains that the document is obscure, and does not touch the question at issue, but raises a new question as to the effect of an excess of births over deaths, saying that "the mortality of a population with an excess of births over deaths is lower than the mortality of a stationary population, where the births and deaths are equal."

Although this is no part of Dr. Letheby's proposition, yet he accepts it as proof of the relationship of births and deaths. It is curious, however, says Dr. Letheby, to note that the registration facts of the country do not support the Registrar-General's proposition, but show that as the excess of births over deaths becomes larger and larger, so also does the mortality of the population. If the registration counties of England be arranged in the order of birth-rates, it will be found not only that the death-rates advance with the birth-rates, but also that the excess of births over deaths becomes larger. Where, for example, the birth-rate ranges from 30 to 32 per 1000 of the population, and the death-rate averages 19·2, the excess of births is only 11·9; where the range is from 32 to 34 per 1000, and the average death-rate is 20·1, the excess is 12·8, and so on, step by step, until we reach an average birth-rate of 39·8 per 1000, with a death-rate of 24·7, when the excess is 15·1. The explanation of all this is to be found in the fact that the mortality of infants is excessively high (46·5 per 1000 in the first month of their existence, and 150 per 1000 in the first year), and that it contributes very largely to the total mortality. In all England and Wales, where the average birth-rate is 35·2 per 1000 of the population, the deaths of children under five years of age amount to 40 per cent. of the total mortality. If this were not so, the natural rate of increase of the population would be prodigious. At present the annual excess of births over deaths in England and Wales is 12·8 per 1000 of the population; but suppose that it was 18 per 1000, as it is in two of the registration counties of England, the population would be doubled about every 40 years; so that the 22,712,266 of the census of 1871 would become rather more than 45 millions in 40 years, and nearly 91 millions in 80 years. In 120 years, or about two generations, it would be nearly 182 millions—which is the estimated population of India. But this sort of thing could never last, for in about 240 years the population of England and Wales, unless it was exported year by year in enormous masses, would reach to rather more than 1550 million persons, who would be as thickly placed over the whole country as the inhabitants of London are at the present moment. Happily this cannot happen, for, despite the views of the Registrar-General, the birth-rate is the controlling element of the death-rate; and before the relative health of different communities can be compared, the apparent rate of mortality must be corrected for the rate of increase by births as well as by immigration.

Another circumstance which seriously interferes with the value of the death-rates, as estimated in the usual way, is the relative proportion of males and females in the population; for, as their death-rates are different (23·3 and 21·5 per 1000 respectively), the common death-rate must necessarily be influenced by it. In infancy and childhood the death-rate of males is nearly 10 per 1000 above that of females; so that in large cities, where women and children abound, the death-rate must be under the normal proportion.

Other circumstances were referred to by Dr. Letheby, and illustrated by examples, as affecting the death-rates of the country. He declared it was absurd to suppose that the mere proportion of deaths to an uncertain population is any proof or evidence of the favourable or unfavourable condition of the health of the people. In determining so important a question, reference must be made to the ages, habits, and employments of the inhabitants; casual immigrants must be distinguished from permanent residents, and the loss by emigration, especially of sick persons, must be inquired into. The proportion of the sexes, the number of births, the vicissitudes of climate and seasons, calamitous events, and other modifying circumstances, must be carefully examined. Until this is done, the death-rate, as usually calculated, and ostentatiously paraded as an indication of salubrity, is not merely ridiculous, but threatens, as Mr. Rumsey says, to become a public nuisance. What more striking proof, indeed, can we have of the untrustworthiness of these so-called "death-rates," as evidences of sanitary progress, than the remarkable fact that they remain unaltered, and, as it would seem, unaffected by such progress? Look at the enormously large amount of sanitary work which has been accomplished in London and in the large towns of England during the last 20 years; yet the death-rates, as calculated in the usual way, remain the same. In the City of London, during the last three decades, the death-rates were 25·29, 24·94, and 25·11 per 1000 of the population. In the whole metropolis they were 24·48, 23·86, and 24·14 per 1000. In the large towns and town districts of England they were 24·45, 23·52, and 25 per 1000, and in the whole of England they were 22·64, 22·11, and 22·69, differences which are insignificant when we consider how much has been done to improve the sanitary condition of the country.

Dr. Letheby then examined the method of determining the sanitary condition of a place by the death-rates at different ages, and he shows that although this is a better method than the last, yet it is not sufficiently accurate for sanitary purposes, inasmuch as the errors of the census, the migrations of the people, and other circumstances, invalidate the results. Taking the death-rate of children under a year old as an example of the difficulties of the case, he shows that the census number of such infants gives most inaccurate results. The census number, in fact, is the number of such infants living on a particular day, and born within 12 months of that day; whereas the deaths which have occurred in the year embrace not only the deaths of those born in the census year, but also of those born in the preceding year, and not a year old at the time of death. Suppose, therefore, that the real death-rate of male infants was 160 per 1000, of this number 50, or nearly one-third of the whole number, will have occurred in the first month of existence, 18 in the second, 13 in the third, and so on in a gradually decreasing ratio to the end of the year, when the number will be less than seven.

It follows from this that every 1000 infants born at regular intervals during the year will lose by death 105 during the census or calendar year, leaving 895 to be registered or enumerated at the time of the census; but the real number of deaths of infants under a year old has been 160—viz., 105 of those born in the census year and 55 of those remaining over from the preceding year. The death-rate, according to this method of computation, will be 160 per 895, or nearly 179 per 1000; whereas the true death-rate is only 160 per 1000. A like error, though not of such magnitude, pervades the whole of the death-rates, and even the aggregate death-rate of the country. It is manifest, therefore, that the death-rates, as usually calculated, are not expressive of facts, and cannot be accepted as reliable exponents of the sanitary condition of a place.

Dr. Letheby concluded his address by referring to the circumstances which must be considered in estimating the salubrity of a place, saying that the sickness and mortality of young children, when properly estimated, are the signs of

home influences; the like phenomena in adults are the indications of wholesome or unwholesome habits, occupations, &c.; and that the sanitary condition of a population can only be properly determined by reference to the statistics of disease, as well as of mortality, and that all the modifying circumstances of age, sex, migration, climate, season, &c., must be carefully considered. He hoped on a future occasion to pursue the subject in this direction.

FIRE AT THE ALLIANCE GAS-WORKS, DUBLIN.

The *Irish Times* of Friday last says: "A most alarming conflagration occurred at the works of the Alliance Gas Company, Great Brunswick Street, this morning. Indeed, at one time the whole of the buildings were threatened with destruction, but, happily, owing to the strenuous exertions of the fire brigade, largely aided by military and civilians, the fire was prevented from being so disastrous as was at first anticipated. Owing to the excitement which prevailed, it was a source of extreme difficulty to obtain accurate information from those in a position to furnish it, so that one was confined to personal observation only, and had no opportunity of ascertaining from officials an approximate estimate of the loss incurred by the shareholders of the Alliance Company. It would seem that as early as eight o'clock fire was discovered in the immense coal shed recently erected, and known by those engaged in the works as the 'Saloon.' An enormous quantity of coal of various descriptions was stored in this structure, and it is conjectured that a portion of it at the northern end became ignited in consequence of the explosion of gas created by the damp condition of the coal. Fortunately enough that fuel which was burning was not of the 'cannel' kind, of which there was a considerable quantity in the building, but was of a less combustible character. Soon after eight o'clock Captain Ingram arrived with one hand engine, and immediately commenced to work on the burning coal. Water was in plentiful supply, both per the Vartry mains and the canal docks, one side of which the coal-shed fronted. Owing to the prevalence of a strong wind, which blew from a north-westerly direction, but little progress could be made in subduing the flames, for, before a stream of water could reach the burning mass, it was robbed very much of its force and volume by the powerful action of the wind. The brigade men, however, worked with indomitable perseverance for some hours, but with small success. Meanwhile the Winetavern Street station had been warned to 'stand by' in case of emergency.

"About twelve o'clock, however, the flames reached the dreaded 'cannel' coal, and the highly inflammable nature of that fuel was painfully but forcibly exemplified. With amazing rapidity the flames spread over the whole building —which is about 80 or 100 yards long by about 30 broad—and that part of the shed adjoining the retorts was soon as much ablaze as the other end where the destructive work had begun. Another hand and a steam fire-engine having been promptly summoned, speedily arrived, as well as hose-carriages and 'pumpers'—in fact, all the available appliances of the fire brigade were put into requisition. The whole building was now enveloped in flames.

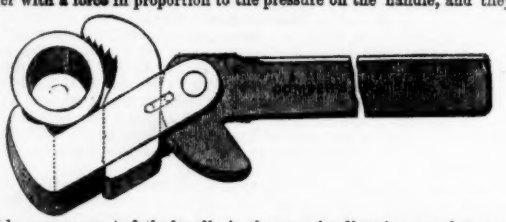
"About a quarter past one o'clock, a detachment of the 3rd Battalion Grenadier Guards, from Beggar's Bush, reached the scene, and rendered valuable assistance by manning one of the hand engines on the quayside, and working it until an advanced hour of the morning. Mr. Cotton, the Secretary of the Alliance Gas Company, was on the spot from the time of the outbreak, and laboured indefatigably with that zeal and good judgment characteristic of him. Captain Ingram caused the steam-engine, supplied with water from the river, to play on the gable end of the building adjoining the retorts, and in about an hour the flames were sufficiently diminished to remove any apprehension as to the safety of that part of the works. The other hand-engine was worked by *employés* in the works, and there were hose-stands playing in the building from the opposite side in Misery Row. Up to the hour of going to press the flames had not been entirely extinguished."

The Dublin correspondent of the *Standard*, writing on Friday night, says: "The fire at the gas-works continued to burn all day, and the fire brigade are still playing upon the burning mass. The amount of loss will not be so great as was at first supposed. The building was insured. The quantity of coal burned cannot be estimated until the fire is completely extinguished."

The latest accounts state that a considerable quantity of coal was removed to a place of safety, and that the fire was effectually subdued.

COMBER'S PATENT PIPE-WRENCH.

At a time when most gas-works are busy with fittings of all kinds, we give an illustration and description of a new patent pipe-wrench manufactured by Mr. W. A. Comber, of Scotland Street Works, Birmingham, which has many special and important features to recommend it. Chief amongst these are firmness of grip, simplicity of action, and reduction in the number and weight of tools. The arrangement, as will be seen, consists simply of two jaws and a cam-headed handle, so placed that the gripping parts of the jaws are brought together with a force in proportion to the pressure on the handle, and they are



opened by a movement of the handle in the opposite direction, so that a quick release is obtained without any jamb. The arrangement admits of the wrenches being made in three sizes only, to reach from ¼-inch to 3-inch pipes, and as in no case do the jaws project beyond the edge of a pipe, it can be seized without disturbance when in a corner or against the flat face of a wall. Spanners for nuts and bolts are also made with a similar arrangement, the gripping-jaws being slightly rounded, for the purpose of securing pressure on the nut sides only.

Fatal Accident to Mr. James G. Glover.—On Wednesday last an inquest was held on the body of this unfortunate gentleman, who was found dead on the morning of the 16th inst., in the front area of his residence, 7, Albert Road, Tollington Park. Mr. John G. Glover, of the firm of Thomas Glover and Co., gas-meter makers, Clerkenwell, identified the deceased as his brother, who travelled for the firm. Evidence was given to prove that deceased parted with a friend at his own door on the night of the 15th, and that he was discovered next morning as described. It was evident that he had fallen over the low parapet which surrounded the area. A verdict of "Accidental death from a fall" was recorded. The funeral took place at Highgate Cemetery on Thursday afternoon, and was numerously attended by the friends and relations of the deceased. On arriving at the gates of the cemetery, the *cortége* was joined by upwards of 200 of the workmen employed by the firm, who formed themselves into a procession. The service having been read in the chapel, the mournful assembly proceeded to the grave, where the remaining obsequies took place. The service was impressively read, and an affecting speech delivered over the grave by an intimate friend of the deceased's. The mouth of the grave was surrounded by a large concourse of friends and relations. The deceased gentleman was much respected in the neighbourhood of Clerkenwell.

BOULEVARD LAMP.

The accompanying engraving gives a representation of some new lamps which have recently been placed in Waterloo Place and Regent Street, between Pall Mall and Piccadilly, and have attracted much attention from their bright and neat appearance. They are the invention of an American engineer, Mr. Joseph Weatherby Bartlett, and we are informed that lamps of this pattern have been extensively used in New York and other cities of the United States, since 1871.

The lantern surrounding the flame is made of crystal glass, in one single piece, and is very thick and strong. It is of an oval or pear shape, the lower part, which encircles the burner, being open at the bottom. The upper part, forming a dome above the burner, is also open at the top, and is provided with a chimney secured to the edges of the opening by clasps. At the part where the dome or upper part merges into the lower part of the lantern, the glass has a flange, or rim, formed round it in the substance of the glass or in one piece with the same. By means of this flange the glass is suspended or supported within any suitably constructed frame.

One of the principal features of improvement in this new lamp is the employment of external reflectors in the position indicated in the sketch. These reflectors are made of metal, their reflecting surfaces being coated with a porcelain enamel. One of them is fixed around the rim, or flange, and the other around the chimney, at the top of the globe. For ordinary street use, the lower reflector is made concave, and about 4 inches in width from the inner to the outer edges. The upper reflector is of a convex form, and is about 6 inches in height from the lower edge, where it is fitted to the chimney to the outer edge, and about 14 inches diameter across the top. A metal cover is fitted on the top of this reflector, for the purpose of conducting away water. Above the lower reflector the band or rim is flattened and ground, to receive in painted or engraved letters the name of the thoroughfare in which the lamp is fixed.

The original cost of these lamps is higher than that of ordinary street lanterns, but from the great strength of the glass employed, the cost of repairs will necessarily be much less. On this point the annual report of the New York Board of Public Works, published in January last, has the following remarks:—"The light given by these lamps is much more brilliant and is more diffused than that of the other style in use; they are entirely free from the heavy shadow which is noticed on the ground about the old lamps. This of itself is a desideratum which should not be overlooked. They are found to be more easily kept clean, and more durable; the thickness of the glass and the peculiar shape thereof enables it to withstand severe usage. It will readily be observed that they are much more ornamental, and present a neater appearance than the old lamps. In order that a comparison may be had between the expense of keeping these new lamps in repair and that of the old style in use, the following figures, taken from the books of this office, are given:—

Number of square lamps in use	16,693	
Average annual cost for each lamp	48	cents.
Number of Bartlett's 'Boulevard' lamps in use	2,217	
Average annual cost for repairing each lamp .	27	cents.

During the past week two of these lamps have been placed in Ludgate Circus, at the junction of Farringdon Street and New Bridge Street. The London agent of the inventor is Mr. G. B. Lincoln, 74, Fleet Street.

APPARATUS FOR ASCERTAINING THE EFFECTS OF PRESSURE UPON CAST-IRON MAINS OF LARGE DIAMETERS.

[Translated from the *Journal de l'Eclairage au Gaz.*]

The rapid development which has taken place during the past few years in the consumption of gas in Paris and the neighbouring communes has led the Paris Gas Company to adopt in their main-laying operations pipes of much larger diameters than those hitherto in use. A pipe of this kind, one mètre in diameter and a kilomètre in length, having recently been laid between the works at St. Mandé and the Place du Trône, it was thought to be interesting to ascertain to what extent cast-iron cylinders of that diameter and of proportionate thickness would be affected, when placed in position, by the application of such an amount of permanent or accidental pressure as would be calculated to alter their shape.

Various experiments had been made with pipes of 0·7 of a mètre in diameter and the result of frequent testings showed that the form of the pipes had in no case been changed to such an extent as to injuriously affect the service. It remained, then, to submit pipes of 1·0 mètre in diameter to the pressures which had produced certain known deformations in those of the smaller size, and to note the results. In this way a solution of the question would be arrived at, which, for practical purposes, would be of greater value than results obtained by arithmetical calculations, which, in this case, are a little uncertain.

The following is the experiment suggested for putting this matter to the test:—

A pipe of 0·7 of a mètre diameter, having an ordinary thickness of 0·001 m., and a pipe of 1·0 mètre, of a thickness of 0·005 m., were laid under similar conditions, and according to the method usually adopted in Paris. The two trenches were dug in such a way that a space of about 10 inches was left between the side of the pipe and the trench, the space above the pipe to the level of the street being rather over 3 feet.

The mains are usually cast in lengths of about 13 feet, but, in order to spread the weight over a larger surface, pipes of rather over 19 feet in length were selected for the experiments, and one end was left open to obtain access to the interior.

The experiments consisted in placing upon the roadway a mass of lead weighing variously from 4 to 20 tons. The weight was laid upon a platform having a superficial area of about 26 feet, constructed of heavy timber. The base of this platform rested upon two soles about 20 in. long by 10 in. wide; these two soles, which were placed about 6 feet apart, were shaped so as to

represent as nearly as possible the follies of two of the wheels of a waggon capable of carrying a burden of 40 tons.

The apparatus intended to measure the deformations was placed in the pipe beneath the platform. It consists of a circular iron disc, over the surface of which nine iron rods, each held and guided by two supports screwed upon the disc, are allowed to travel. A spiral spring, pressing with one end against the interior support, and with the other against a shoulder-piece fixed to the rod which it surrounds, supports the upper end of the latter against the side of the pipe.

The supports which are nearest the centre are furnished with an iron screw, by means of which the rods may be secured, and the operation of fixing the apparatus in position greatly facilitated.

The rods in the interior of the apparatus are intended solely as supports, and to keep it in such a position in the pipe that its centre shall coincide with that of the section under experiment. These rods are each provided with a catch, to ensure their steady action, and are tightened by the pressure of the screws on the two guides. It follows from this arrangement that any depression taking place in the vertical diameter of the pipe is measured by the distance from the centre to the extremity of the vertical rod.

The central opening of the disc, which has a diameter of about 7½ inches, is closed by means of an iron plate encased in leather. This plate is furnished with a hinge, and works against a reversed rib, upon which it is fixed by a swivel. It has upon it a catch to limit the size of the opening, and upon the opposite side, in the centre, there is a pin for the purpose of holding a disc of paper.

Each rod, with the exception of those in the lower part of the apparatus (which, as has been remarked, act simply as supports) has upon its end, near the centre of the paper disc, a puncturing arrangement, consisting of an iron tube, up which passes a small rod, having on one end a copper button and on the other a small round plate of the same metal, fitted with a needle point. A small spiral spring pressing against the button keeps the needle-carrier against the tube which acts as a sheath for the rod.

All the rods of equal length being free to move, owing to the flexibility of the springs, under the influence of pressure transmitted to them from the sides of the pipe, it is evident that the variations in the distance between the heads of the two radii on the prolongation one from the other will be the exact measure of the alterations in diameter the pipe has sustained in this direction.

By pressing the finger upon the buttons on the rods carrying the needles, the paper disc on the plate (which is covered with leather to avoid blunting the needles) is pierced with a small hole. In this manner the positions of the points corresponding with a given weight are registered very exactly, and by measuring upon the paper the data thus determined, a series of records are obtained by which the results of the various experiments may be easily ascertained—the pressure to which the pipe has been submitted, and the time occupied by the experiment, being indicated above each diagram.

In order to facilitate as much as possible the process of recording the comparative results of these testings, the company have had diagrams prepared representing one-half of the profiles of the upper part of the pipes of 1 mètre and 0·7 mètre diameter; these profiles, taken from corresponding diagrams obtained by the apparatus, show the deformations produced by a pressure of about 20 tons acting for 130 hours.

It will be seen by a comparison of the two sections that, in a vertical sense, the two pipes were affected in the following manner:—The pipe of 1 mètre diameter yielded to the extent of 0·0285 of a mètre, or 2·85 per cent. of its original diameter; that of 0·7, to the extent of 0·031, or 4·43 per cent.

The conclusion arrived at from the experiments has, therefore, been that the pipe having a diameter of 1 mètre and a thickness of 0·005 of a mètre offers conditions of resistance relatively superior to those which are presented by the pipe of 0·7 of a mètre, which had been previously submitted to the test of practice with a thickness of 0·004 of a mètre.

The examination of the diagrams taken shows that, when a pipe has been, so to speak, *ovalized* by the pressure of the earth upon it, the original form is only recovered to a very trifling extent when such pressure ceases to act.

Since these experiments were undertaken, the pipe of 1 mètre diameter has been laid in one of the side walks of the Cours de Vincennes, between the works at St. Mandé and the Place du Trône. In proportion to the position of the pipe, the joints have been tested with compressed air under a pressure of 70 m.m. of the manometer, independently of the proof to the extent of five atmospheres to which the pipes had been submitted before leaving the works. These tests led to the discovery of a few leaks of little importance, which were rectified before the earth was filled in.

The pipe of 1 mètre diameter is now in frequent use, with highly satisfactory results.

IRON AND COAL TRADES OF SHEFFIELD, SOUTH YORKSHIRE, AND NORTH DERBYSHIRE.

(FROM OUR OWN CORRESPONDENT.)

The iron trades of this locality are again pretty well off for work, and in many instances it begins to be apparent that there will be an average amount of employment (at least) throughout the winter months. This is mainly the case with those industries with which we are most concerned here, such as the foundries, engineering works, and brassfoundry establishments. Messrs. Newton, Chambers, and Co., Thorncliffe Iron-Works and Collieries, near Sheffield, have just blown in two new blast-furnaces, constructed in the most approved manner. For the use of these furnaces the firm are bringing considerable lots of ironstone from Northamptonshire and North Lincolnshire, and have also opened out an extensive limestone quarry in the Peak Forest district of North Derbyshire. These furnaces will produce, when at work, about 400 tons of pig iron per diem.

Most of the blast-furnaces in the vicinity of Sheffield, Rotherham, Elsecar, Sheepbridge, Staveley, and Clay Cross, are kept going to the full extent of their producing powers. Much of the pig iron so made is worked up into castings on the spot, there being still a good inquiry for pipes for gas and water purposes.

The principal brass-works are quite unable to deal with their numerous orders as rapidly and punctually as is required, the chief obstacle being the scarcity of competent workmen. The bulk of the output in this branch is on account of the leading London and provincial gas and water companies. The inquiry for taps, cocks, hydrants, and plumbers fittings, is much above the average.

Taken in the aggregate, the coal trade of South Yorkshire and North-East Derbyshire is tolerably brisk, the remark being more particularly applicable to the house coal department. Steam coal is also in encouraging request, at figures ranging between 10s. and 12s. 6d. per ton. Slack coal is to be had at very low prices, pit slack being about 2s. 6d. per ton, and screened nuts at 6s. to 7s. 6d. per ton at the pit mouth. During the nine months ending the 30th of September the tonnage of coal sent by railway to London was on a much smaller scale than during the corresponding period of last year. The Midland carried 1,155,218 tons, and the Great Northern 609,605 tons, the Great Eastern showing to good advantage with 463,590 tons. During September alone the Midland carried 147,714 tons, the Great Northern, 86,464 tons, and the Great Eastern 60,205 tons. Of Silkstones, the Great Northern carried 15,500 tons, and of the thick Barnsley coal 21,300 tons. The Derbyshire pits sent an increased quantity over the Midland. Nine of them sent 103,000 tons in the month, as against 77,100 tons in August. Langley Mill and Clay Cross alone sent 4200 tons more than during August.

IRON AND COAL TRADES OF SOUTH STAFFORDSHIRE AND EAST WORCESTERSHIRE.

(FROM OUR OWN CORRESPONDENT.)

The improved demand for most classes of finished iron is fairly maintained, and prices show continued firmness. Most of the works now find full employment, and the tone of business is steadier and altogether more satisfactory. Messrs. Barrows and other leading makers still adhere to the standard of £11 for marked bars, but bars of fair quality may be had as low as £10 10s. Hoops range from £11 15s. to £12 10s. per ton; common rods, £10 10s.; sheets (singles), £13; and other descriptions in the usual proportion. A much better inquiry is experienced for plates for ship and boiler purposes, and, as the shipping trade is steadily reviving, a still more active business in this department of the trade is generally looked for.

The bridge and girder yards are quiet, and proprietors complain sorely of the severe competition of the Cleveland district, which, just now, appears to possess a considerable advantage over South Staffordshire in respect of lower prices and freights, London being the chief market for this class of engineering ironwork.

Wrought tubes are in better request both on account of the home and colonial markets, and makers now speak much more hopefully of the prospects of business.

Pig iron of nearly all descriptions is in decidedly improved demand, and sales are now readily effected. All-mine hot-blast pigs are quoted £3 5s. to £3 10s. per ton, and cold blast £6 10s. per ton, and common cinder £3 5s. Chilled rolls and other heavy machine castings are this week declared down 20s. per ton, and the ironfounders report a steadily improving demand, gas and water pipes being prominent features of inquiry.

The demand for coal is increasing, and prices are firm at late quotations. The colliers have all settled down at the drop, the rate of wages now paid being for thick coal colliers 4s., and thin mine workmen 3s. per day of eight-hours. Owing to the number of new pits which have been opened since 1871, the supply of engine slack has overtaken the demand, and large stocks are accumulating, but slack of best quality fairly maintains its value. An important colliery, of 40 acres extent, in the neighbourhood of West Bromwich, which had been water-logged for some years, has recently been cleared by an enterprising firm, and is now in full operation.

Much satisfaction is expressed at the activity displayed by the Mines Drainage Commissioners, and there is little doubt that the output of coal in the South Staffordshire district will be considerably augmented shortly.

Coke is in abundant supply, and prices are in favour of the buyer.

THE COAL AND IRON TRADES OF LANCASHIRE.

(FROM OUR OWN CORRESPONDENT.)

The coal trade in the Manchester district continues very brisk in consequence of the increased pressure brought upon it by the strike in West Lancashire. Prices, although not generally quotably higher in the Manchester market, are very much stiffer all through, sellers getting more money, where they find this possible, and to most of the outside districts quotations have been advanced.

For all classes of house coal there is an exceptionally active demand, much more than can be accounted for by the requirements for actual consumption, and it seems probable that a considerable amount of stocking is taking place, so that a lull in the trade may probably be looked forward to before long. Good furnace and engine fuel are also in active demand, and dealers in some cases are screening the latter description for household purposes. Common sorts also find a ready sale; in fact, for any description of coal there is at present a demand, and colliery proprietors in the Manchester district continue to receive far more orders than they can execute.

The trade in coal for gas-making purposes is rather quiet, the usual mode of buying causing a slackness just now, business springing up again early in December. This applies particularly to cannel, but for ordinary gas coal there are a number of inquiries in the market from consumers whose contracts have been cancelled by the strike. There is, however, very little offering in the market, and prices are firm.

The coke trade has slightly improved; there are more inquiries, and prices are firmer. Lancashire made cokes ranged at the pit from 13s. to 14s. for small, to 22s. and 23s. per ton for large.

In the Liverpool market supplies have been short, especially in steam coal, and some of the steamers have been compelled to put off with considerably less than their usual complement. Prices are slightly higher generally, and in some cases considerably more money has to be paid to secure supplies.

I hear rather conflicting reports respecting the strike in West Lancashire. On the one side it is said that the masters in a few cases are showing signs of giving way, and on the other that many of the men are dissatisfied, and anxious for a settlement. They are, however, very exceptional cases were the masters do not remain firm, and amongst the men there are no general indications that they are likely to give way at present, and there is every prospect that the strike will be protracted for at least a week or two longer.

An improved state of things has been perceptible in the iron trade of this district. Middlesborough pig iron delivered is much firmer, prices having advanced 1s. to 1s. 6d. per ton during the past week, No. 3 foundry being now quoted at 74s. 9d., and No. 4 forge at 67s. 3d. per ton. In manufactured iron there has not been much change, except that heavy rails have declined about 2s. 6d. per ton, whilst angle iron and bridge plates have advanced about 5s.

Some of the local furnaces and forges are inconvenienced in obtaining supplies of good hard, as makers are not in a position to pay the price asked for from other districts.

THE COAL AND GENERAL TRADE OF THE NORTH OF ENGLAND.

(FROM OUR OWN CORRESPONDENT.)

There has been an improvement in the general tone of the coal trade since last week. Household coals have been in active demand at from 15s. 6d. to 16s. per ton, best qualities. The best gas coals are in pretty brisk inquiry, and are held pretty stiffly at 13s. per ton; middling are quoted from 10s. per ton upwards. Manufacturing coals are a little more looked after, but there is no improvement to note in the value of small coals. There still remains a good deal of uncertainty with regard to the settlement of wages disputes in the Durham and Northumberland coal trade. There is an impression that the arbitration in the Durham district will ultimately go to the umpire for final settlement, and that the result of the arbitration will be adverse to the men. How the wages question will be finally arranged in the Northumberland district it is difficult to say, but it is hoped the points in dispute in this district will also be settled through arbitration.

The demand for coasting tonnage, both steam and sailing, continued to improve last week, and the quotations for London were pretty firm at from 7s. to 7s. 3d. per ton, with other coasting ports in proportion. French coal freights were from £9 5s. to £9 10s. per keel. As sailing vessels keep scarce, it is evident, without more steamers are introduced into the coasting trade, rates must get higher. The shipping business to the Continent, especially Germany and Holland, is not nearly so good as the coasting.

There is not much new to report in the iron trade of this district. Business has been rather quiet, though prices keep pretty steady. Finished iron is not in such request. The pig iron market at Middlesborough was tolerably firm last week, and a deal of business was transacted. The demand for foundry iron, though not so brisk as it was some time ago, is stated to be active, and prices were quoted last week as follows:—No. 1, about 70s.; No. 3, 65s.; and No. 4 forge 58s., cash.

The chemical trade of the Tyne is very flat at present; there is no speculation; stocks, however, are low, and if there were a slight revival of business prices must go up. The general manufacturing trade of the North has not changed much in October. Trade has been very quiet in all departments, and it has been void of every element of speculation. The failures which occurred the week before last at Newcastle in no way affected general business, which may be described as essentially sound in this part of the world. It is very slowly but very surely working its way back to what may be called its normal state, and though the prices of coals are never likely to reach the same height they did 18 months or two years ago, they will not probably fall to the same dead level of the period before the rise. Since the beginning of the year, house and manufacturing coals have fallen between 20 and 25 per cent.; steam coals, about 12 per cent.; and gas coals have ranged between 10s. and 13s. per ton, according to quality. Steam coals undoubtedly will get lower, whereas gas coals, though decidedly stiffer than they were a month ago, are not likely to advance much upon the present quotations during the winter months.

The masters and men in the Northumberland colliery district have agreed that the trade dispute there shall go to arbitration, so all danger of a stoppage or crisis in that trade is gone, and we may expect a steady business this week.

Explosion of Gas in Salford.—On Monday evening, Oct. 19, an explosion of gas occurred in the house of Mr. Thomas Rogers, 18, Alfred Street, Sussex Street, Lower Broughton. About half-past eight, Mr. Rogers went into the front room of his house with a lighted candle, intending to light the gas. It is supposed that he pulled the chandelier too low, and that the gas escaping became ignited at the candle flame. The force of the explosion which followed shattered every window in the house, and its shock was felt in the whole neighbourhood, which was also greatly alarmed by the noise. The injuries sustained by Mr. Rogers necessitated his removal to the Salford Dispensary, though they are not supposed to be dangerous. Mrs. Rogers who sat in the adjoining room, suffered a severe shock, which, in her condition at the time, it is feared may be still more injurious, and a young man named Brady, who was also sitting in the back room, was thrown off his chair by the concussion. He was not, however, seriously hurt.

Execution against the Dublin Corporation.—The Water-Works Committee of the corporation have issued a report in vindication of themselves from the charge of neglect made against them on account of their omission to lodge an appeal against the rating of the city mains, and allowing a judgment for over £8000 to be obtained by the Collector-General, which is ready to be put into the hands of the sheriff. They state that the matter was taken out of their hands by the council and transferred to the Finance Committee, but they admit that, having ascertained that the latter committee recommended the management of the case should be undertaken by them, they directed their secretary to put himself in communication with the law agents. The Finance Committee, however, though their intention became indirectly known, did not submit their report for confirmation by the council until after the time had lapsed, and so between the two committees and the council nothing was done, although notice of the rating was received in January, 1873, and it was at once resolved to appeal against it. The occurrence has not tended to raise the character of the corporation, or induce the citizens to place more confidence in it.—*The Times.*

Bedlington Water Supply.—At the monthly meeting of the Bedlingtonshire Local Board, a letter was read from Mr. Arnold Taylor, the Local Government Board inspector, who recently conducted an inquiry into the state of the water supply of the district. Mr. Taylor recommended that the local board should instruct their engineers, Messrs. Meik and Nisbet, to make the necessary additions to their plan and estimate, so as to provide the district with a supply of water from the Blyth, equal to 20 gallons per head per day for a population of 20,000 people. When this was done the local board would have to apply to the board in London for sanction to borrow the larger sum which these extensions would demand. He proposed not to report on the recent inquiry until he knew what determination the local board had come to on this question of extension. If they adopted his suggestions, they would, perhaps, find it expedient to take the needful steps to obtain a Provisional Order. The local board resolved to adopt Mr. Taylor's suggestion, and directed the clerk to take the necessary steps to obtain a Provisional Order to enable them to take lands and properties for the purpose of making filter-beds, storeage reservoirs, &c., for the proposed water supply, and also to obtain rights to protect the river from pollution in its upper sources.

Register of New Patents.

643.—Trueman, H., Woodbridge, "*Improvements in apparatus for measuring liquids.*" Patent dated Feb. 26, 1874.

This invention relates to a simple and convenient apparatus for accurately measuring all kinds of liquids, being constructed with an outer case at the bottom, into which the fluid to be measured is admitted, till it reaches a level determined by a float connected with a valve. In the bottom of the case a tube is placed, having a vessel fitted to slide vertically upon it. The raising and lowering of the sliding vessel on the tube is effected by means of a wheel and rack, which are connected to a lever which describes an arc over the face of a graduated disc.

662.—West, D. K., Kentish Town, Middlesex, "*Improvements in engines to be driven by water and steam, and in pumps.*" Patent dated Feb. 21, 1874.

According to these improvements, a number of cylinders, arranged with their axes parallel to each other, contain pistons caused to act successively on the surface of a conical disc working on a corresponding inverted fixed cone, thereby imparting to the disc a rolling motion, which is communicated through an arm or arms to the crank. The pistons may be worked by means of an ordinary slide valve driven from the shaft, or a rotary valve or valves worked from the disc.

679.—Lake, W. R., Southampton Buildings, London, "*Improvements in air-tight joints for gas-retorts.*" A communication. Patent dated Feb. 23, 1874.

This invention relates to forming an air-tight joint for gas-retorts by attaching to the lid a fillet of lead extending around it near the edge; and providing the outer face of the flange surrounding the neck of the retort with a corresponding rib or projection that respresents a sharp edge, which by pressure of the lid against the neck is forced into the lead.

697.—Braidwood, J. F., Phœnix Gas-Works, Bankside, "*Improvements in apparatus for securing the lids or covers of gas and other retorts.*" Provisional protection only obtained. Dated Feb. 24, 1874.

This invention has for its object a more speedy and effectual means for securing the lids of gas and other retorts to their mouthpieces, and is carried out in the following manner—viz., the cross-bar is hinged at one end by preference to the left-hand lug (or ear); the other end of the cross-bar is thickened and bevelled at the outer edge which enters the top part of the lug, and fits a similar bevel at its outer end. In the centre of the cross-bar there is a slotted hole through which the pin whereon the holding levers move is passed. There is also attached to this cross-bar a set screw and lock nut actuating a steel die or pressing block, for the purpose of regulating the distance of the centre pin (carrying the holding levers) between the cross-bar and retort-lid. The centre of the cross-bar is thickened by bosses for the purpose of giving additional stability to the holding levers when pressing against the retort-lid. The holding levers are actuated by the top one being elongated, and carried at right angles to form the handle, the end being bent upwards for greater convenience in working. The bottom lever is connected to the top one by the pin already described as passing through the slotted hole in the cross-bar. On the ends of the levers which press against the retort-lid are attached two wedge-shaped cams having a partial rotative motion, which is regulated by two stops. The required pressure on the lid is obtained by the set screw, lock nut, and steel die on the cross-bar as described.

702.—Weston, J. H., Lansdowne Road, Surrey, "*Improved means of and apparatus for purifying, carburetting, and increasing the illuminating power of coal gas.*" Patent dated Feb. 24, 1874.

According to this invention the gas to be acted upon is conducted into a chamber provided with a series of vertical radiating diaphragms with spaces for the free passage of the gas from the lower level of an inlet-pipe to the upper level of an outlet-pipe. Each of the radial diaphragms is hollow, the walls perforated with holes, the inner spaces or chambers filled with sponge or other fibrous material capable of holding in absorption volatile spirits or liquids. The lower portion of the chamber is supplied to the required depth with hydrocarbon or other fluid from the reservoir above. The liquid passes through a passage or seating capable of being closed by a balance-valve or plug governed and controlled in its action by a float for ensuring the perfect action of the feed-valve, and for regulating the level of the liquid in the lower or carburetting chamber.

When the liquid in the lower chamber is filled to the required level, the float is raised and by its action on the lever the valve is closed, the supply of liquid being cut off when no gas is being consumed, consequently no derangement can occur. When the gas is turned on, its passage through the carburetting diaphragms causes it to become purified and charged with the volatile hydrocarbon spirit held in absorption, and as the liquid is consumed or taken up, so it is replenished by the valve aperture without waste, and without the possibility of its flooding the lower chamber to close the lower inlet-pipe by which the supply of gas would be shut off.

A cylinder or column is fitted in the apparatus, the cylinder having a series of holes which communicate with an outlet-pipe by which any superfluous charge of liquid in the lower chamber may be drawn off at pleasure. The float is so arranged as to ensure its perfect action on the feed-valve, and is surrounded by a perforated casing which is carried below the bottom of the lower chamber and forms a well, an outlet-plug being fixed for the purpose of drawing off the liquid or cleansing it from impurities as occasion may require. The supply inlet to the reservoir is lined with a finely perforated strainer, as well as the covering of the valve-seat, for the purpose of preventing the introduction of grit or other foreign matter into the inner chamber.

717.—Robinson, A. H., Merrion, Ireland, "*Improvements in meters for measuring water and other liquids, and in motive-power engines, parts of such improvements being also applicable to flushing water-closets and preventing waste of water.*" Patent dated Feb. 25, 1874.

This invention relates to a simple and effective means of measuring and indicating the quantity of water or other fluid passing through a meter, and consists of a peculiar arrangement of valves and mode of actuating the same, parts of which arrangements are applicable to hydraulic and other motive-power engines, and to the flushing of water-closets and preventing waste of water.

In carrying out the invention it is proposed to employ a cylinder of a given capacity through which the fluid to be measured is caused to pass, having a piston working therein by the pressure of the inflowing fluid. Attached to or in connexion with the cylinder is a valve case or chamber, in which are situate two inlet-valves carried on the same spindle, one at each end, facing the inner ends of the valve chamber, which form the valve seats, and these are the inlet ports to the measuring cylinder of the meter or the cylinders of the engine when the invention is so applied. This valve chamber is in connexion with the main or supply pipe, and is at all times filled with the incoming fluid. It has also two other valve chambers, each being provided with a double valve, the principal one in each being that which closes and opens alternately the outlet ways or parts of the cylinder, the other acting, when the outlet port is open, as a stop against the back pressure of the cylinder on the inlet valve, and is constructed to ensure the closing of the outlet port at the required moment. The outlet ports discharge into a water space, which communicates with the delivery-pipe.

For the purpose of operating the inlet valves a rod is employed, which passes through a stuffing-box into the valve case or chamber first referred to, and is provided with a stud or suitable projecting piece, which works in a longitudinal slot in the valve spindle, and actuates it. To the outer end of this rod a lever is attached, which is connected by means of an adjusting link or other suitable means to a cross-head or arm made rigid on the piston-rod. This piston-rod in its passage up and down actuates the lever, which operates the inlet valves by opening and closing one or other alternately, thereby changing the current of the incoming fluid, which in its passage to the measuring cylinder, or the cylinder of the engine as the case may be, closes the valve of the outlet passage or port at that side. The outlet valve at the other side is caused to rise by the discharge from the cylinder and allow a free passage for the measured fluid to the water or or other space which communicates with the delivery or exhaust pipe, and at the same time the upper part or back is caused to act as a stopper against the back pressure of the cylinder on the inlet valve at this side, which was closed on the opening of the inlet valve at the other side. The current of water or other fluid and the consequent motion of the piston in the cylinder are changed each time the inlet valve is reversed.

720.—Woodcock, J., Plymouth, "*Improvements in valves for regulating the supply of water to cisterns or tanks.*" Patent dated Feb. 25, 1874.

This invention relates to ball-valves for regulating the admission of water to cisterns, tanks, and other receptacles. The valves are arranged to close the inlet aperture by moving across it, so that in the act of closing no pressure has to be exerted to keep back the water, and no matter how great may be the pressure in the pipes, it will have no tendency either to open or close the valves.

733.—Somerville, J., Dublin, "*Improvements in the method of manufacturing gas for lighting and heating, and for the apparatus used therein.*" Patent dated Feb. 27, 1874.

These improvements relate, firstly, to carbonizing coal or other gas-making materials in retorts, chambers, or ovens, of such capacity as to admit of a much larger quantity of coals being operated upon at once; and, secondly, in the construction of such apparatus as shall be especially adapted for carrying out the system. With this view retorts, chambers, or ovens are constructed of bricks or blocks moulded for the purpose, and are built of various sizes to meet the requirements of different works; but the size preferred is about 20 feet long, 10 feet high, and 18 inches wide at bottom, but tapering to 1 foot wide at top. Each retort is closed at the bottom by one or more doors hinged to the bottom, or made entirely removable on a travelling frame or otherwise, the doors being composed of cast or wrought iron, partially or wholly covered with bricks, tiles, or fire-clay, in such a manner that when closed a bottom of refractory material is formed for the coal or other material to rest upon. The top of each retort is closed by one or more lids or doors, which are either luted or surfaced so as to make a sound joint between it and the top of the retort, each of which is also furnished with one or more pipes for the exit of the gas, and may be coated with cement or glazed to prevent the adherence of the coke.

When two or more retorts are set side by side, a furnace is constructed between them and heats the sides of both by an arrangement of ascending and descending flues, which terminate in a short chimney, or the products of combustion may be carried into one chimney common to the whole range. The furnace door is situated on the top of the retort stack, and the fuel is introduced by a hopper or otherwise. The fire-bars are made with a frame of cast or wrought iron bars, with recesses formed in them so as to admit of fire-bricks or other refractory

substance being inserted, and removed from time to time when requiring renewal. The ash-pit floor is made sloping, so that clinker or ashes, on falling, slide down into a receiver so arranged that on being opened the contents will fall into a barrow or other receptacle for removal.

The exit-pipe from each retort is led into a small chamber, into which also is led a pipe communicating through the conducting main with the condenser. These two pipes are provided with a cover, which is divided into two compartments by a partition extending from the top to near the bottom. The chamber being furnished with water, and the pipes being covered, no gas can pass from one pipe to the other; but upon the bell being raised sufficiently to withdraw the division plate from the water a free passage for the gas is formed.

From the chamber just described the gas passes on to the condenser, which consists of a series of pipes of, by preference, about three or four inches in diameter, but admitting of variation. These pipes are connected at each end with a chamber, the gas being made to pass from chamber to chamber in a zig-zag direction together with the products of condensation, and at each chamber are received in bulk and broken up into separate streams, and again collected in bulk until the end.

The retorts or chamber are charged with coals from a waggon or waggons made to run along a tramway above them, and when charged, the lower doors or bottom being previously secured, the upper doors are closed and the coal left to distil, the gas passing off by the exit-pipe to the condensers, as previously described. The coals may, however, be supplied to the waggons by a hoist or any suitable contrivance.

The retorts are built upon arches or columns and girders sufficiently high to admit of waggons or trucks passing beneath them, so as to receive the coke when the retorts are discharged; and the lower doors of the retorts may be so contrived as to slide out or be lowered on to a frame or truck, and if desirable constitute the bottom of the truck.

734.—HUGHES, N. H., Ayr, N.B., "*A new or improved self-registering fluid or liquid measurer.*" Patent dated Feb. 27, 1874.

This invention consists of a bucket wheel contained inside of a casing, and capable of revolving on its axis. The fluid to be measured passes it near the top or side of the casing so as to enter and fill the buckets of the wheel. The weight of the liquid in some of the buckets causes the wheel to revolve and discharge the liquid or fluid through an opening in the lower part of the casing.

The buckets are constructed of any required capacity, and their cubical contents being known affords a basis for measurement of the liquid or fluid which has passed through them, so that by indicating the number of revolutions made by the bucket wheel the quantity passed through the apparatus is known. The axis of the bucket wheel is provided with a pinion for actuating toothed gearing by means of which a finger or pointer is operated and caused to indicate upon a dial; or the axis of the bucket wheel may have an arm attached to it for actuating a stop or pointer in a volute or spiral groove, the position of the stop or pointer in the groove affording the indications required.

752.—MALLINSON, J., Welwyn, Herts., "*Improvements in steam and other cocks.*" Patent dated Feb. 28, 1874.

These improved cocks are constructed with a plug having a way or ways through it and received into a shell in which are inlet and outlet passages as usual. A space is left round the plug, between it and the shell, except at the inlet and outlet passages, where bosses or enlargements are formed which come up to the sides of the plug. Packing is introduced into the space left round the plug both above and below the bosses or enlargements, by means of which the cock is maintained steam, gas, or water tight.

768.—LANDAU, M. I., Saint Mary Axe, London, "*Improvements in miners safety lamps and in other lamps; also in burners, and in applying lamps for various purposes, and in apparatus for supplying and regulating gas, and for ventilating.*" Patent dated March 3, 1874.

These improved lamps are made with annular chambers having perforated rims for the circulation of air, parts being without perforations, and openings being made in the chamber for circulation of air; bayonet joints or similar contrivances being used for connecting the upper and lower portions of the lamps together. Burners are constructed with orifices arranged around the edge of a dome or cap, and with holes drilled obliquely; also with holes formed below the ignition point to expand the gas. The gas flow is regulated by valves or plugs. Burners are combined to produce annular flames. Hollow supports for globes or chimneys conduct air to the flame. Copper burners, cones, or caps are used. The gas passages and gas-regulating material are coated or covered with lime or other purifying substance, and the tops of burners are plated, lime washed, or covered with lime.

793.—COOKE, J., and MYHILL, W. H., Birmingham, "*Improvements in cocks or taps for high or low pressure.*" Provisional protection only obtained. Dated March 4, 1874.

According to these improvements the valve or diaphragm in the cock or tap is worked by a cam eccentric or snail wheel turning against a piston worked by the fluid pressure or by a spring and the cam. A lever may be substituted for the cam.

APPLICATIONS FOR LETTERS PATENT.

3567.—ASHWORTH, G., and ASHWORTH, E., Manchester, Lancs, "Improvements in steam-pumps or pumping-engines." Oct. 17, 1874.

3577.—COLEMAN, J. J., Glasgow, "Improvements in the production of volatile liquid hydrocarbons from hydrocarbon gases, and in the apparatus employed therefor." Oct. 17, 1874.

3583.—MURDOCH, H. H., Staple's Inn, London, "A process for quickly drying and carbonizing spent tan, and obtaining therefrom its essential oil, tar, gas, &c." A communication. Oct. 17, 1874.

3611.—LACK, P. J., Westmoreland Place, London, "Improvements in valves for regulating the supply of gas, and in other fittings connected with gas-burners." Oct. 20, 1874.

GRANTS OF PROVISIONAL PROTECTION.

3439.—HUGGETT, J. A., Ferndale Road, Clapham, Surrey, "Improvements in ball-valves." Oct. 7, 1874.

3455.—WESTERBY, T. W., New Wortley, Leeds, Yorks, "Improvements in pressure and vacuum gauges." Oct. 9, 1874.

3459.—HALLSWORTH, S., Armley, near Leeds, and BAILES, R., Woodhouse Carr, Leeds, Yorks, "Improvements in the mode of treating and clarifying sewage or other impure waters." Oct. 9, 1874.

3460.—M'KAY, W., Carnoustie, N.B., "A new or improved apparatus for heating by gas." Oct. 9, 1874.

3464.—PARKES, S. H., Birmingham, Warwick, "Improvements in gas and other lamps." Oct. 9, 1874.

3469.—KÖRTING, E., Manchester, Lancs, "Improvements in the method of and apparatus for revivifying the materials or agents employed for purifying gas used for lighting and heating purposes." Oct. 9, 1874.

3471.—KÖRTING, E., Manchester, Lancs, "Improvements in the mode of and apparatus for compressing and rarefying fluids applicable for forcing, driving, or drawing gases through liquids or other matters, and also for filtering and for other useful purposes." Oct. 9, 1874.

3472.—SCOTT, H. Y. D., Ealing, Middlesex, "Improvements in the manufacture of ammoniacal salts." Oct. 9, 1874.

3487.—FOULIS, W., Glasgow, "Improvements in charging and drawing retorts, and in the machinery or apparatus employed therefor." Oct. 10, 1874.

3500.—TAPLAY, H., Stafford, "Improvements in the construction of chandeliers, gaseliers, and other similar apparatus." Oct. 12, 1874.

3525.—KIRTLEY, J. G., Monkwearmouth, Sunderland, Durham, "An improved filtering apparatus." Oct. 14, 1874.

3545.—JOHNSON, R., Bradford, Yorks, "Improvements in machinery for exhausting and propelling air, gas, and other fluids and liquids." Oct. 15, 1874.

3549.—HAMILTON, J., Smethwick, Stafford, "Improvements in direct-acting pumps." Oct. 15, 1874.

NOTICES TO PROCEED.

1958.—STACEY, J. T., and LACE, A., Newbury, Berks, "Improvements in the construction and arrangement of apparatus for carburizing atmospheric air to be employed for illuminating and other purposes." June 5, 1874.

2245.—MORGAN, O. V., Kensington, London, and MOELCHAEREK, G. R., Battersea, Surrey, "Improvements in stoneware filters and coolers for filtering and cooling water." June 29, 1874.

3243.—PEACOCK, J. C., Finsbury Park Road, and BRADLEY, C. W., Circus Place, London, "Improvements in the manufacture of illuminating and heating gas and distributing thereof for use by means of apparatus adapted for said purposes." Sept. 22, 1874.

3352.—LYNDE, J. H., Sale, Chester, "An improved apparatus for saving water in water-closets, urinals, and other places where a fixed quantity of water is required at each operation." Oct. 1, 1874.

3366.—BECK, J., Cornhill, London, "Improvements in the process and apparatus employed in the working and condensing of oxygen and hydrogen gases." A communication. Oct. 2, 1874.

PATENTS WHICH HAVE BECOME VOID

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £50 BEFORE THE EXPIRATION OF THE THIRD YEAR.

2696.—MILBURN, R., and BROWNING, T., "Improvements in apparatus for drying and treating sewage deposit and some other matters." Oct. 11, 1871.

2714.—STERNE, L., "Improvements in meters for water, gas, and other fluids." Oct. 13, 1871.

2755.—MANN, A., "Improvements in taps or valves." Oct. 17, 1871.

2760.—POW, J. B., "Improved arrangements for filtering and purifying, also for collecting for utilization the solid matter in suspension in sewage, especially applicable for obtaining pure potable waters." Oct. 17, 1871.

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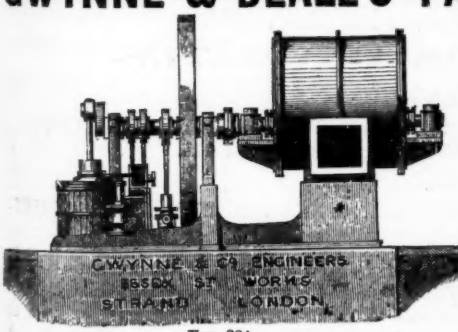

FIG. 224.

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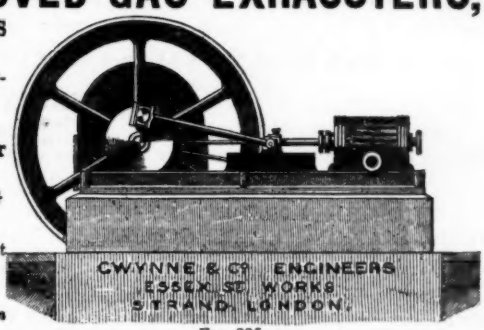

FIG. 225.

Fig. 224 represents one of those erected at the Imperial Gas-Works, Bromley, capable of passing 210,000 cubic feet of gas per hour. Several others of the same size are now on order for the same Company. These Patent Machines combine the highest quality of workmanship and materials, the largest bearings and wearing surfaces, with the **most perfect system of action yet discovered.** Fig. 225 represents one of a series of four at the Nottingham Gas-Works, each passing 52,500 cubic feet per hour. GWYNNE AND CO. *do not pretend to enter into a struggle with other makers in respect to cheapness. They have never sought to make price the chief consideration, but to produce Machinery of the very highest quality, and the most approved design and arrangement.* Their prices have been estimated with a due regard to the **excellence of the article produced,** and when this is taken into consideration, they have no fear for the result. The orders executed this season for Exhausters and alterations to their patented system amount to over 4,000,000 cubic feet of gas passed per hour, and to over 300 horse power for Engines to drive them. In every instance their work is giving the greatest satisfaction. Numerous testimonials and references can be given.

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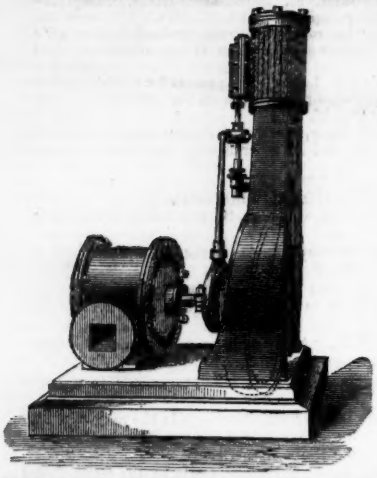

WITH

ENGINE COMBINED

ON

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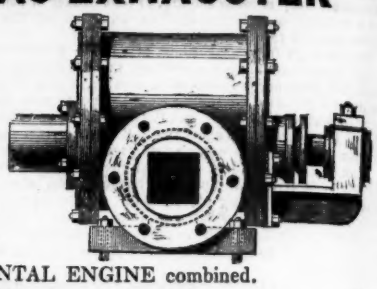

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As supplied to the Imperial, Chartered, and other London and Provincial Gas Companies. Bellows and Valves for inflating Well Dresses, Stokers Gloves, India-Rubber Suction and Delivery Hose, Gas-Tubing, Leather India-Rubber and Gutta-Percha Machine-Bands, Sheet and Washers and Steam Joints.
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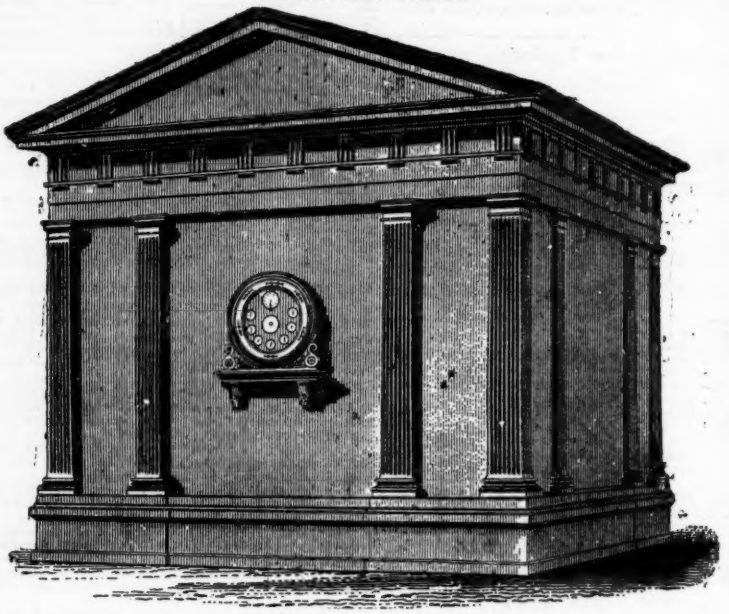
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WATER-METERS SUITABLE FOR ALL PRESSURES.
Home and Foreign Orders promptly attended to.
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And every description of Gas-Fittings and Gas Apparatus.

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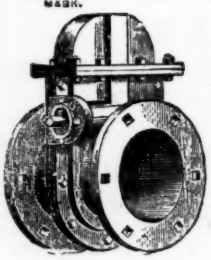
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SPENCE'S PATENT DRY COPPERAS.

The only purifying material which removes by one process, without injury to the purifiers, all Ammonia and Sulphuretted Hydrogen. It has been in use for upwards of five years at some of the largest Gas-Works in the Kingdom.

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"UNIVERSAL" STEAM PUMP

WAS AWARDED, AT THE

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"The simplest machine of its kind."—*Engineering.*

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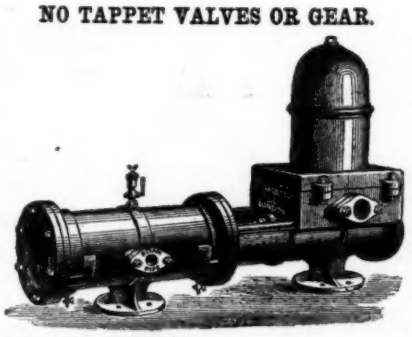

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FOR

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One selected from amongst many Testimonials received by H. T. & Co.:—

"*Ardwick Bridge Chemical Works, Manchester, Oct.* 28, 1872.

"Sir,—The 'Universal' Steam Pump obtained from you, and which has been employed during the last six months pumping caustic soda at these works, still continues working satisfactorily. "Yours truly,

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Same quality as supplied by us to several of the most extensive Gas Companies, and which has given entire satisfaction.

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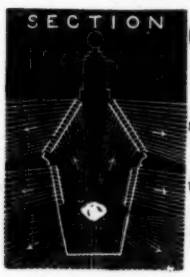
It requires but one trial to prove the Superior Make, Strength, and Durability of these Sieves.



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Is now in use in Moorgate Street, Cheapside, and Trafalgar Square, and has been in successful operation upon Waterloo Bridge since Oct. 7, 1871.

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Can offer a CANNEL COAL yielding a large quantity of Gas of superior quality.
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POPE & PEARSON'S GAS COAL.—We have now the authority of several of the most eminent Gas Engineers of London in stating that our Coal yields *in practical working over* 10,000 *cubic feet of gas, with an illuminating power of* 16 *candles;* or by the standard burners now used by the London Gas Companies, an illuminating power equal to 17½ candles.
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Orders of any magnitude, for home and exportation, executed with all possible despatch.
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AND ALL MATERIALS FOR GAS MANUFACTURE AND DISTRIBUTION.

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And every Description of Gas Apparatus.
GAS, STEAM, AND WATER FITTINGS.

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LAMP REGULATOR

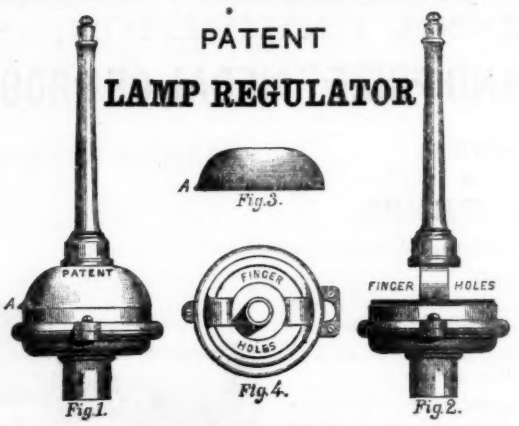

Fig.1. Fig.3. Fig.4. Fig.2.

D. BRUCE PEEBLES AND CO.,
ENGINEERS, WET AND DRY GAS-METER MANUFACTURERS,
PATENTEES OF
GAS REGULATORS FOR PUBLIC LAMPS, FACTORIES, PUBLIC HALLS, AND DWELLING-HOUSES.

Attention is respectfully requested to the following extract from a lecture "On the Economical Combustion of Coal Gas," delivered to the Philosophical Society of Glasgow, by Dr. W. Wallace, F.R.S.E., F.C.S., Gas Examiner for the city of Glasgow, on the 4th of March last:—
"A few years ago, a simple form of Gas Regulator for Street Lamps was introduced, I do not know by whom, and various forms of it, and improvements on it, have been made by many practical gas engineers. Of all the modifications of the instrument, the best in my opinion is that of Mr. D. Bruce Peebles, of Edinburgh; in fact, his Lamp Regulators are so superior that they are likely to supplant all others. Already about 9000 of these have been applied to the street-lamps in Glasgow, and I understand it is the intention of the authorities to introduce them all over the town. The saving thereby effected I calculate to be about £6000 per annum, without any diminution of light. One of the great advantages of Mr. Peebles's apparatus over all others is that it can be regulated while the gas is burning."
Since the above date, another 1000 have been supplied to Glasgow, and they are being largely adopted at home and abroad.

D. B. P. and Co. are prepared to Estimate for the Supply and Maintenance of their Regulators, and will be glad to forward terms on application.

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RETORT SETTINGS, heated by tar without the production of smoke.
STEAM-ENGINES and EXHAUSTERS, separately or combined.
FOUR-WAY VALVES, one of which is equal to three ordinary Valves.
STATION GOVERNORS—the Gasholder cannot tilt and cause accident.
BREEZE AND TAR FUEL MACHINE.

A Pamphlet containing Eighteen Illustrations of the foregoing, with letterpress on the construction of Works, post free, 2s. 6d.

N.B.—The second edition of this Work, *now ready*, contains Illustrations of the Machine for converting Breeze and Tar into Fuel for heating the Retorts.

"The Author is well qualified to speak authoritatively upon the important subjects to which his pamphlet refers."—*Artizan.*

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COPPA COLLIERY, MOLD,

Beg leave to call the attention of Gas Companies to the superior quality of their

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This Cannel produces in actual working, in iron retorts, 9200 cubic feet of 32-candle gas, and upwards of 11 cwt. of coke, and in clay retorts will produce 11,500 cubic feet of 25·9-candle gas.

Ports of shipment—Birkenhead or Connah's Quay.

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MUIRKIRK, No. 1, CANNEL

Yields 11,600 cubic feet of 34·3-candle gas per ton, and 10 cwts. of excellent coke, containing only 5 per cent. of ash.

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Yields 10,700 cubic feet of 32·77-candle gas per ton, and 9½ cwts. of coke, containing 11 per cent. of ash.

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NEAR SHEFFIELD,

STRONGLY RECOMMEND A TRIAL OF THEIR

CELEBRATED SILKSTONE GAS NUTS.

Analysis by F. J. EVANS, Esq., Chartered Gas Company, Horseferry Road, Westminster:—

(COPY.)

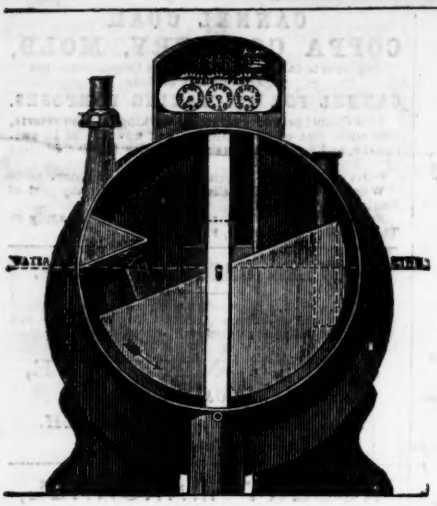
	Cubic Feet of Gas per Ton of Coal.	Illuminating Power in Candles.	Coke per Ton of Coal used.	Ash in Coke, per Cent.	Sulphur in Coal, per Cent.
Silkstone Nuts . . .	10·800	15·85	12·66 cwt.....	6·0	0·69

NOTE.—The illuminating power of the gas was tested by the standard burner now used in London by the Gas Referees, under the City of London Gas Act, 1868.

Horseferry Road, Westminster, March, 1870. (Signed) F. J. EVANS.

These Nuts are extensively used by various Gas Companies throughout the Kingdom, who bear strong testimony to their value.

APPLICATIONS FOR PRICES, &c., TO BE SENT DIRECT TO THE COLLIERY, AS ABOVE.



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"Unquestionably the best Water Gas-Meter now in use."—THOS. G. BARLOW, C.E.

Over 90,000 in action.

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WITH

Branch Manufactories at DUBLIN and OLDHAM.

Established

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THE ORIGINAL

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NEAR LEEDS,

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FIRE GOODS, and Salt-Glazed Drain-Pipes.

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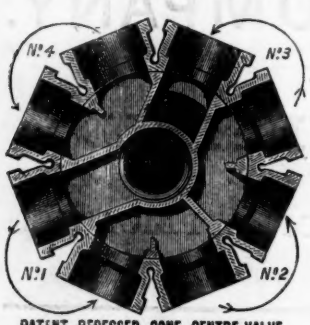
Where is always kept a Stock of Retorts, Fire-Bricks, Terra Cotta Ware, and Drain-Pipes.



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Sectional Plan.

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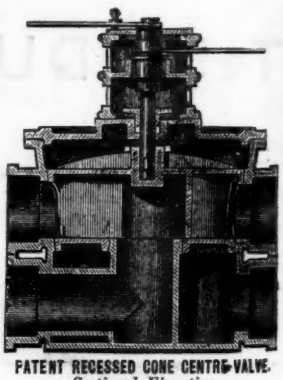
Constructed on the principle of the ordinary Plug-Cock.

THROUGH-WAY & FOUR-WAY COCKS

Of all descriptions.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Invite the attention of Gas Companies and the Trade generally to their Improved GAS-METERS, which they warrant equal to any in Quality, Workmanship, and Simplicity of Construction, and the only Meters from which Gas cannot be obtained without being duly registered.

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DOUBLE CONE, ALBERT, SHADOWLESS, & EVERY DESCRIPTION OF BURNER, UNION JETS, BATSWINGS, ETC.;

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GAS-STOVES, and every article connected with Gas Apparatus.

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Boyle's Patent Silvered Glass Combination Reflectors and Outside Lanterns.

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